

**System/Subsystem Design Description (SSDD)
Phase 2**

United States National Data Center (US NDC)

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System/Subsystem Design Description, Phase 2, Revision B: United States National Data Center

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1. Scope

1.1 Identification

This System/Subsystem Design Description (SSDD) defines the United States National Data Center (US NDC) Phase 2 Operational System, the Alternate (Alt) US NDC, and the US NDC Phase 2 Training System designs. The US NDC Operational System is located at the Air Force Technical Applications Center (AFTAC) at Patrick Air Force Base (PAFB), Florida, and the Alt US NDC and the US NDC Phase 2 Training System are located at Goodfellow Air Force Base (GAFB), Texas.

The *System Requirements Document for the United States National Data Center (Phase 2)*, defines US NDC Phase 2 Operational System requirements. The *Systems Requirements Document for the United States Data Center (Phase 2), Appendix A*, defines US NDC Phase 2 Training System requirements. The *System Requirements Document for the United States National Data Center (Phase 2)* defines the Alt US NDC system requirements. The *System/Subsystem Specification (S/SS) for the United States National Data Center (US NDC) (Phase 2 Build 1)* defines the Operational System and Training System specifications. The Alt US NDC S/SS defines the Alt US NDC. The US NDC Operational System design described in this document is traceable to the *System Requirements Document for the United States National Data Center (Phase 2)* and the US NDC Phase 2 Training System design described in this document is traceable to the *System Requirements Document for the United States National Data Center (Phase 2), Appendix A*. The Alt US NDC is traceable to the *System Requirements Document for the United States National Data Center (Phase 2)*.

Note: Further references in this document to the US NDC System apply to the Phase 2 US NDC System and references to the Alt US NDC apply to the backup system at GAFB.

1.2 System Overview

AFTAC is tasked with monitoring compliance of existing and future nuclear weapons testing treaties. To perform this mission, AFTAC uses several different monitoring techniques, each designed to monitor a specific physical domain (i.e., space, atmosphere, oceans, and underground) of nuclear explosions. Together these techniques form the United States Atomic Energy Detection System (USAEDS). The current US NDC Phase 1 Operational System collects and analyzes data from USAEDS seismic arrays, three-component seismic stations, and hydroacoustic stations. A few of these stations and arrays are also part of the International Monitoring System (IMS).

The system upgrade objective described in this document is to update the US NDC Phase 1 Upgrade System. While maintaining the Phase 1 Upgrade system functionality, new capabilities are added to the Operational System.

1.3 Document Overview

This document is prepared in accordance with (IAW) *Data Item Description (DID) DI-IPSC-81432/T* for an SSDD as tailored in CDRL B001. Section 1 provides the scope of the US NDC System and this SSDD. Section 2 provides a list of referenced documents. Section 3 summarizes the system-wide design decisions for the system. Section 4 describes the US NDC System architectural design including all system hardware and software components, the concept of system execution, and the interface design issues. Section 5 provides a traceability matrix between system-level requirements and system components. Section 6 provides a listing of acronyms and definitions used in this document.

2. Referenced Documents

Air Force Manual (AFM) 33-270, Command, Control, Communications, and Computers (C4) Systems Security Glossary, 08 August 1994

System Requirements Document for the United States National Data Center (Phase 2), Document Number 1001901, 7 September 2001

System Requirements Document for the United States National Data Center (Phase 2), Document Number 1001901, Revision B, 15 November 1999

AFTAC Distributed Subsurface Network Data Link Processor (DLP) Design Document, Version 1.0, February 14, 1995, Sandia National Laboratories

ADSN Technical Manual, Operation and Maintenance, Central Terminal, Part Number 930-54260-0101 through 930-54260-0110, 17 November 1992, Change 2 - 9, June 1994, TI 2-CT-1 Volume 1

CSS Version 3 Database: Schema Reference Manual, Revision 1.2, Science Applications International Corporation (SAIC), January 1995

International Data Centre (IDC) Documentation, Formats and Protocols for Continuous Data CD-1.0, Products and Services, Section 3.4.2, SAIC-98/3005, May 1998

International Data Centre (IDC) Documentation, Formats and Protocols for Messages IMS-1.0, Products and Services, Section 3.4.1, Revision 2, SAIC-00/3005

Database Design Description (DBDD) Phase 2, Revision A, United States National Data Center (US NDC), SAIC 01/3047, 17 May 2002

United States National Data Center (US NDC) Phase 1 Upgrade Technical Manual, Installation, Operation, Principles of Operation, Maintenance, Illustrated Parts Breakdown, and System Diagrams, TI 2-NDC-2, 26 July 2001

United States National Data Center (US NDC) Phase 1 Upgrade Technical Manual, Operation, Principles of Operation and Fault Verification, TI 2-NDC-1, 18 April 2001

United States National Data Center (US NDC) Program Parts List (Phase 2), Revision -, SAIC-02/3000, 07 March 2002

United States National Data Center (US NDC) Reliability, Maintainability and Availability Report (Phase 1), Version 2.0, SAIC-99/3029, 22 October 1999

United States National Data Center (US NDC) Security Plan, Version 1.0, SAIC-98/3027, 17 June 1998

*United States National Data Center (US NDC) Software Version Description (Phase 1),
Version 1.0 (Draft), SAIC-99/3027, 04 October 1999*

*Interface Control Document (ICD) for United States National Data Center (US NDC)
Phase 2, Revision B, SAIC-00/3042, 17 June 2002*

3. System-wide Design Decisions

The US NDC Operational System receives raw waveforms from both classified and unclassified sensors distributed worldwide. Once gathered, the waveforms are stored and archived for immediate and delayed processing. The system provides a raw waveforms management capability and allows the data to be analyzed using geophysical algorithms for the detection and identification of man-made seismic events (i.e., nuclear detonations).

The following subsections describe the system-wide design decisions and constraints applied to the system development to meet its operational goals.

3.1 United States National Data Center Software Baseline

The set of AFTAC-desired applications and functionality developed by the Center for Monitoring Research (CMR), provided in Release 3 (R3), and the AFTAC-unique applications and functionality contained in the US NDC Phase 1 System comprise the system software baseline.

3.1.1 Continuous Data Subsystem

The US NDC Phase 2 software supports both the Continuous Data-1.0 [(CD-1.0) (also called Alpha)] protocol [see International Data Centre (IDC) documentation, *SAIC-98/3005, Formats and Protocols for Continuous Data CD-1.0, Products and Services, Section 3.4.2,*] and the Continuous Data-1.1 (CD-1.1) protocol for the acquisition and forwarding of continuous waveforms between data centers. The US NDC also acquires waveform data from external systems, which currently do not use either continuous data protocol, including the AFTAC Distributed Subsurface Network (ADSN) and Los Alamos National Laboratories (LANL) Systems.

Internally, the Phase 2 System utilizes the CD-1.1 protocol for waveform data forwarding from the Unclassified System to the Classified System and from the US NDC Operational System to the Sustainment System. The receiving processes convert US NDC-acquired waveform data that is not CD-1.1 protocol to CD-1.1 protocol prior to any subsequent use or data forwarding.)

3.1.2 Database Schema

The US NDC Phase 2 database design is based on the Center for Seismic Studies (CSS) Version 3.0 database schema (see *CSS Version 3 Database: Schema Reference Manual*). To meet mission needs, the design contains CMR- and AFTAC-developed schema changes and extensions. The resulting US NDC schema is documented in SAIC-02/3047, *United States National Data Center (US NDC) Database Design Description (DBDD)*.

3.1.3 Inter-process Communications

The US NDC data processing software requires an application-level communication layer to isolate the complexity of socket-based UNIX Inter-process Communications (IPC) messaging. This layer is composed of developed software incorporating the commercial product Tuxedo. Modes of operation primarily include communications among automated processes running on the data processing server and communications among interactive applications running on an Analyst Workstation.

3.2 Air Force Technical Applications Center Distributed Subsurface Network Data Acquisition Subsystem

The US NDC System acquires waveform data from certain US stations through the ADSN Data Acquisition Subsystem. The ADSN continues to provide the intermediate data relay to the US NDC until the stations are upgraded to provide data directly to the US NDC.

The Phase 1 Upgrade System requests re-transmission of incomplete waveform data from sources, transmits calibration signals to AFTAC-controlled sites, receives state of health (SOH) data and other control signals from AFTAC-controlled sites, and accepts status information from unclassified sites. These requirements continue to be met using the existing ADSN System capabilities for seismic stations. The US NDC also provides, using government-furnished equipment (GFE), the procedural capability to meet the requirement for transmitting calibration to hydroacoustic stations.

3.3 System Security Design

The following subsections provide a system security design decisions overview [see SAIC-98/3027, *United States National Data Center (US NDC) Security Plan* for details].

3.3.1 Unclassified/Classified System Interface

The US NDC is separated into Classified and Unclassified Systems. All waveform data acquired by the Unclassified System is transmitted to the Classified System, where the waveforms are processed, analyzed, evaluated, and archived.

To protect the Classified System from access, it is necessary to implement a SABI-approved communications solution that ensures the one-way transfer of waveform data from the Unclassified System to the Classified System. This solution is often referred to as a data diode.

The US NDC Phase 2 Build 1 System utilizes a Trusted Computer Systems, Inc. commercial product called the Trusted Gateway System (TGS). The software solution is built upon the Sun Microsystems Trusted Solaris Operating System (OS) and makes use of its secure file-system capabilities. All data transferred through the TGS are in file format only. A US NDC process places Unclassified System files into a writable file system provided by the TGS. The TGS then

transfers the files to a separate TGS file system which is designated as read-only accessible to the Classified System.

3.3.2 Operating System Security

The US NDC System meets high security mode requirements as defined in AFM 33-270, *C4 Systems Security Glossary*. The system uses the commercial UNIX Solaris OS, which provides the configurable identification, authentication, and discretionary access control features necessary to meet these requirements. The US NDC continues to employ the commercial product Solaris SHIELD Basic Security Module, a part of the Solaris OS which provides the necessary audit security features to meet the requirements. In addition, the public domain Transmission Control Protocol (TCP) Wrappers software is installed and configured on the system to restrict and control network access to the US NDC.

3.3.3 Air Force Technical Applications Center Firewall and Classified Local Area Network

The US NDC is protected from unauthorized access outside the AFTAC building with a firewall using packet-filtering and a proxy service. The AFTAC Directorate of Logistics and Systems (LS) provides a firewall and an all building-internal classified data exchange infrastructure.

3.4 Sustainment System

Due to complex networking and cost considerations, the US NDC Sustainment System is designed and configured to receive waveform data forwarded from the operational system rather than having an independent data path. The US NDC Operational System is designed to perform such forwarding function with minimum load on its data gathering processing and archiving performance. To facilitate testing, verification, validation, and upgrades to the US NDC Operational System software, Configuration Management (CM) controls all software on the Sustainment System.

3.5 Hardware

The US NDC System is designed to have a mission Mean Time Between Critical Failures (MTBCF) of no less than 2,160 hours, exclusive of software errors, assuming continuous operation when operating in a controlled environment and a Mean Restoral Time (MRT) of no more than 21.8 hours, exclusive of software errors.

3.6 Department of Energy Knowledge Base Products

The US NDC System provides support for third-party software integration, in particular Department of Energy (DoE) Knowledge Base (KB) products. This includes the integration of source-dependent travel-time correction surfaces and a Geographical Information System (GIS) product that may ultimately replace the existing US NDC map display component. The mapping

environment employs ArcView, a commercial Off-the-Shelf (COTS) product, DoE-developed project files, and ArcShell, an SAIC-developed IPC product. The current design enables both the new and existing mapping facilities to coexist.

3.7 Alternate United States National Data Center

The Alt US NDC provides a functionality comparable US NDC located at GAFB, Texas, IAW S/SS requirements. The Alt US NDC is co-located with the Alt ADSN.

The Alt US NDC operates in standby mode while the US NDC mission is performed at PAFB. In standby mode, US NDC equipment operating at PAFB receives sensor data in multiple formats and immediately forwards it in CD-1.1 format, via a Government-furnished Wide Area Network (WAN) between PAFB and GAFB, to Alt US NDC equipment. The Alt US NDC receives continuous data from PAFB and maintains its own data archive so that historical data is available at GAFB to support the mission as needed.

When the mission is transferred to the Alt US NDC, the Alt US NDC operates in mission-performance mode. To enter this mode, the data feed through the CACI network circuits is switched so that only the equipment at GAFB receives the sensor data. In mission-performance mode, the Alt US NDC continues to archive the data it receives but, unlike the US NDC, it never forwards this data to the other site. Though the capability exists at the Alt US NDC to forward continuous data to the US NDC, enabling this would only complicate the mission return process, which is expected to begin immediately after the equipment at PAFB is operational.

Although forwarding CD-1.1 data accommodates a major portion of populating the Alt US NDC with mission data, there is other data (e.g., beams and database alphanumerics) that also must be synchronized between the US NDC and the Alt US NDC. Synchronization of alphanumeric data tables is accomplished through the use of Oracle Replication. Propagation of beams and their associated **wfdisc** and **wftag** entries is accomplished by means of newly developed custom software.

Immediately after returning the mission to the US NDC, data originally received by the Alt US NDC is not yet available at the US NDC. To make this data available, a process known as backfilling is implemented to replicate the missing data from framestores (and from the archives for long duration mission transfers) to the US NDC. Backfilling can occur via the WAN between GAFB and PAFB for relatively short duration mission transfers or via magnetic tape for longer duration mission transfers. Alternatively, at the operators discretion, certain backfilling time interval subsets can be assigned to occur across the WAN while other backfilling time interval subsets are assigned to occur via tape.

The Alt US NDC is unmanned and automatic data processing (i.e., pipeline processing) does not run until the mission is transferred to GAFB. A 21-inch monitor added to the Unclassified Data Acquisition Manager (udam) and Classified Data Acquisition Manager (cdam) Workstations in System Control at PAFB displays US NDC and Alt US NDC hardware status and alerts graphical representations.

The critical design decisions in developing the Alt US NDC involve insuring that all the data needed for the Alt US NDC to assume the mission is replicated from the US NDC. A variety of replication techniques were considered for the Alt US NDC, including the following:

- COTS filesystem-level replication products from Sun and Veritas
- Oracle database replication (included with Oracle Server Enterprise Edition)
- Custom-built software or scripts designed with our specific data structures in mind
- Use of existing US NDC capabilities, such as data forwarding

As previously discussed, there are three types of dynamic data that need to be replicated on the Alt US NDC: raw waveforms, beams, and alphanumeric processing results. Different replication techniques are used for each data type, as described in the following subsections.

3.7.1 Replication of Raw Waveforms

Use of COTS Sun Network Data Replicator or Veritas Storage Replicator filesystem replication products was considered for this application. These products monitor input/output (I/O) at the filesystem block level and ensure that any changes to the disk blocks of a source filesystem are replicated in the corresponding target filesystem. However, such products have to be operated synchronously (i.e., each change to the source is immediately propagated to the target and confirmed) to ensure consistency. Synchronous replication would make the US NDC vulnerable to an outage of either the Alt US NDC or the WAN link between the sites. On the other hand, use of CD-1.1 forwarding insures diskloop/**wfdisc** consistency and buffers data destined for the Alt US NDC in the event of a communications outage.

For these reasons, COTS filesystem replication products use (Sun Network Data Replicator or Veritas Storage Replicator) was rejected and the data forwarding capability inherent in the software that implements CD-1.1 protocol was selected to replicate the raw data at the Alt US NDC. A Frame Exchange (*FrameEx*) process at the US NDC is configured to forward all data to the Alt US NDC. Likewise, the Alt US NDC, a *FrameEx* process is configured as a receiving site for data forwarded from the US NDC. The *FrameEx* process at the Alt US NDC then places its received data in a framestore and a *DLParse* process periodically reads the framestore, places the received data into the diskloop file system, and writes the appropriate **wfdisc** records. Both the US NDC Unclassified and Classified Systems are configured to forward data received from external sources only to their Alt US NDC counterparts. Data received on the US NDC Unclassified System reaches the Classified Alt US NDC System via the TGS at the Alt US NDC. This prevents data from being forwarded across the WAN twice.

The forwarding process is only used for replication of raw data from the US NDC to the Alt US NDC. The design decision regarding replication of beams is described in Section 3.7.2. Data recovery upon mission return from the Alt US NDC to the US NDC at PAFB uses an entirely different technique (see Section 3.7.4).

3.7.2 Replication of Beams

Beam waveform files could also be replicated via the COTS filesystem products, but the same considerations apply as stated in Subsection 3.7.1. Since beams cannot be forwarded in the manner of raw waveforms, the Alt US NDC design incorporates a new software process called *BeamRep* to copy beam files from the US NDC System to the Alt US NDC System via the classified channel on the US NDC WAN. The *BeamRep* process synchronizes the **wfdisc** and **wftag** entries for the beams transferred as the beam files are copied. More detail on the *BeamRep* process is provided in Subsection 4.2.7.1.2.

3.7.3 Replication of Alphanumeric Processing Results

Oracle Replication can be operated synchronously or asynchronously. Synchronous replication ensures database consistency at all times, but makes the master database dependent on the minute-to-minute target availability and the connection between them. Asynchronous replication allows batches of transactions to be queued on the master database for deferred execution on the target database if the link goes down. Accordingly, the US NDC application uses asynchronous replication between the master and target databases for alphanumeric processing results.

3.7.4 Data Recovery from the Alternate United States National Data Center to the United States National Data Center

When the mission returns to the US NDC following the end of an outage, the data that accumulated at the Alt US NDC while it was performing the mission must be recovered and reintegrated into the US NDC data structures. Simply turning the replication processes around and making them replicate from the Alt US NDC from the US NDC is not a suitable technique for accomplishing data recovery. The data replication processes used for forward replication (i.e., from the US NDC to the Alt US NDC) run continuously, looking for new data to be replicated/forwarded and sending it to the Alt US NDC in near real-time.

However, when the Alt US NDC has the mission, the US NDC is presumed to be unavailable. If the continuous replication processes were simply turned around, the database transactions, forwarding frames, and beam file changes would queue up waiting for the link from the Alt US NDC to the US NDC to become active. If the outage is long enough, the queues and frame buffers would fill up and cause the Alt US NDC to either hang or suffer data loss. Accordingly, the US NDC does not use continuous reverse replication to recover data accumulated at the Alt US NDC but uses special techniques to resynchronize the data structures contents at the two sites. A suite of US NDC software processes called *BackfillImport*, *BackfillExport*, and *BackfillInsert* recovers data files (both raw data and beams). A suite of Oracle PL/SQL processes included in the Oracle Replication product recovers data processing results in the Oracle databases. These processes are included in two PL/SQL packages called **DBMS_RECTIFIER_DIFF** and **DBMS_REPUTIL**. These processes allow the database administrator to detect and rectify differences between replicated tables in multiple databases.

4. System Architectural Design

4.1 System Components

The US NDC Phase 2 Build 1 System supports several operational functions. The functions provide the following:

- Ability to acquire seismic, hydroacoustic, infrasound, and radionuclide data
- Capacity to process seismic and hydroacoustic data
- Advanced analysis techniques for seismic data
- Capability to forward seismic and hydroacoustic data to the CMR and other users
- Staged archiving of data, and permanent data storage

The following subsections describe the functional system architecture in terms of its functional subsystems and its physical architecture in terms of its software, hardware, and manual operations.

4.1.1 Functional Architecture

Figure 1 provides a US NDC Operational System functional architecture block diagram. It shows that the US NDC consists of both an Unclassified and a Classified System. The Unclassified System consists of an Unclassified Data Acquisition Subsystem and an Unclassified Archive Subsystem. The Classified System consists of a Classified Data Acquisition Subsystem, a Classified Analysis Subsystem, and a Classified Archive Subsystem. Table 1 describes the subsystems' functions.

Figure 2 provides a US NDC Training System functional architecture block diagram. This is a limited functionality system, comprised of Classified Training and Training Analysis. Classified Training and Training Analysis together are equivalent to the Classified Analysis Subsystem of the US NDC Classified System. Table 2 describes the subsystems' functions.

Functional analysis showed that there was considerable overlap in the functionality required by each subsystem. This led to an allocation of functions for each subsystem into major functional components and further to a combination of software, hardware, and manual operations. Section 4.1.2 describes these components.

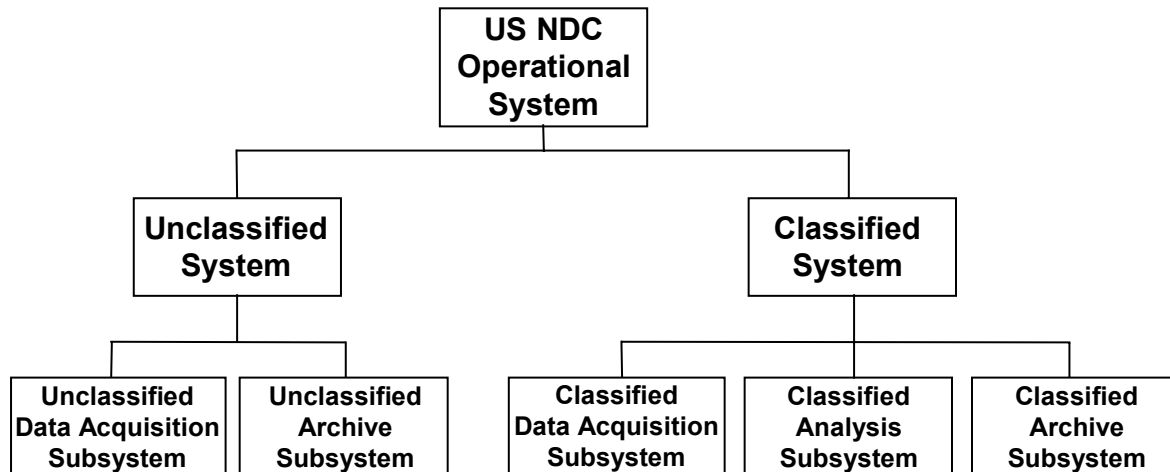


Figure 1. United States National Data Center Functional Architecture Block Diagram

Table 1. United States National Data Center Functional Subsystems

SUBSYSTEM	FUNCTIONALITY PROVIDED
Unclassified Data Acquisition Subsystem	Acquires data from unclassified external sources, and forwards data to unclassified external sources and the Classified Data Acquisition Subsystem. Provides capability to monitor data acquisition and forwarding.
Unclassified Archive Subsystem	Archives unclassified waveform and alphanumeric data. Provides capability to monitor archiving processes.
Classified Data Acquisition Subsystem	Acquires data from classified external sources and from the Unclassified Data Acquisition Subsystem. Securely submits information regarding suspected missing waveform data to Unclassified Data Acquisition Subsystem for re-transmission. Provides capability to monitor data acquisition and manually submit re-transmission requests.
Classified Archive Subsystem	Archives all waveform and alphanumeric data. Provides capability to monitor archiving processes.
Classified Analysis Subsystem	Processes all waveform data using geophysical algorithms. Provides automatic processing and interactive analysis capabilities. Provides control of automated processing and capability to monitor processes.

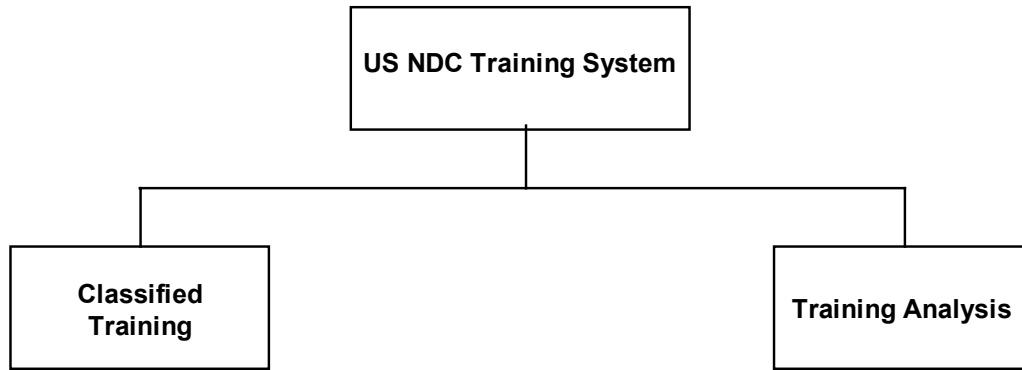


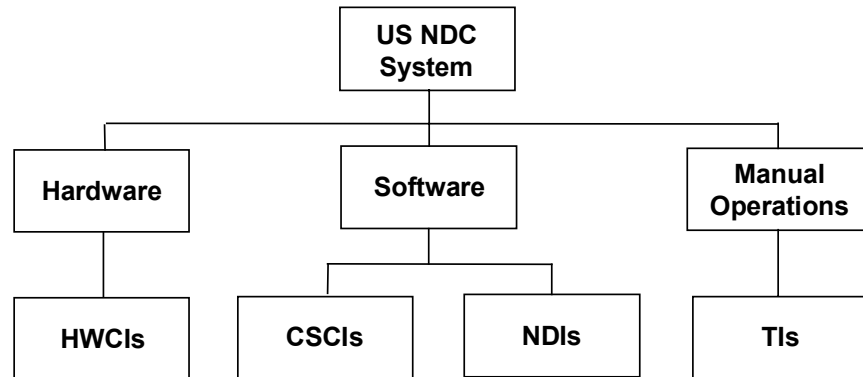
Figure 2. United States National Data Center Training System Functional Architecture Block Diagram

Table 2. United States National Data Center Training System Functional Architecture

PORTION OF TRAINING SUBSYSTEM	FUNCTIONALITY PROVIDED
Classified Training	Provides instructor-student interaction processes. Includes database and system administration tools unique to the Training System.
Training Analysis	Duplicates a portion of the Classified Analysis Subsystem.

4.1.2 Physical Architecture

Figure 3 provides a US NDC Operational System and Training System physical architecture block diagram. Both systems have the same physical architecture. The diagram shows that the systems consist of hardware, software, and manual operations. The hardware is composed of several Hardware Configuration Items (HWCIs). The software is composed of several Computer Software Configuration Items (CSCIs) and Non-developmental Items (NDIs). Sets of Technical Instructions (TIs) govern the manual operations. The following subsections describe the hardware, software, and manual operations in more detail.



**Figure 3. United States National Data Center
Physical Architecture Block Diagram**

4.1.2.1 Software Architecture

This section describes in order the CSCI and non-developmental item (NDI) components, which make up the US NDC Operational System and Training System software.

4.1.2.1.1 Computer Software Configuration Items

The CSCIs are based on a number of criteria including, among others: functionality, code size, interface design, and software engineering paradigms. The Training System contains an Operational System CSCIs subset. Table 3 lists the CSCIs and provides a brief description of each.

**Table 3. United States National Data Center
Computer Software Configuration Items**

CSCI	DESCRIPTION
Data-Services	Provides waveform data acquisition and waveform data forwarding.
Automatic	Provides automated geophysical processing, including signal detection, signal processing, signal identification, signal association, event formation, event location, and event magnitude computation.
Interactive	Provides interactive analysis capabilities, including review of automated processing results, interactive measurement, geographical mapping, analysis and review of event data, event location, event magnitude, and event identification and context.
Distributed	Provides control and monitoring capabilities for processing within other CSCIs, including system status and processing status.
Monitoring	Provides geophysical performance reports for analysis of system performance, as well as comparisons with other systems.

**Table 3. United States National Data Center
Computer Software Configuration Items (Continued)**

CSCI	DESCRIPTION
Tuning	Provides functionality for testing and configuring parameters used for automated processing, including training neural networks, computing Bayesian inference tables, creating and viewing grid files, and generating synthetic event and detection data sets.
Data-Management	Provides data management for all other CSCIs, including definition of database structure and configuration files.
Common	Provides libraries and utilities that are shared by more than one of the other CSCIs.

The following subsections provide descriptions of each CSCI's major components. The complete list of source files for all components is provided in SAIC-99/3027, *United States National Data Center (US NDC) Software Version Description (Phase 1)*.

4.1.2.1.1.1 Data Services Computer Software Configuration Item

The Data Services CSCI is composed of software which performs the acquisition and forwarding of waveform data in the Unclassified Data Acquisition Subsystem and Classified Data Acquisition Subsystem. The Data Acquisition function provides external interface connection management, continuous data receiving, and data conversion of the various data formats received to the CD-1.1 format, interval processing, and disk loop management for the Unclassified Data Acquisition Subsystem and the Classified Data Acquisition Subsystem. The Data Forwarding function provides forwarding of data to external systems for the Unclassified Data Acquisition Subsystem, and data forwarding and data recovery between the Unclassified Data Acquisition Subsystem and the Classified Data Acquisition Subsystem. The Data Parsing function provides waveform segment decompression, time ordering, storage, and waveform segment completion status for the Unclassified Data Acquisition Subsystem and Classified Data Acquisition Subsystem. The major components for each of these functions are listed in Tables 4, 5, and 6, respectively.

Table 4. Major Data Acquisition Components

COMPONENT	DESCRIPTION
FrameEx	Receives data from the CD-1.1 protocol stations and places the data in the data framestore.
ConnMgr	Manages connections between stations and the US NDC.
StationToFS	Receives data from Data Transaction Center (DTC) and CSS 3.0 protocol stations, converts the data to CD-1.1, and places the data in the framestore.
LateData	Provides a means of requesting data not received by the US NDC from DTC protocol stations in CSS 3.0 format.
DLMan	Receives data from CD-1.0 protocol stations, converts the data to CD-1.1, and places the data in the framestore.

Table 5. Major Data Forwarding Components

COMPONENT	DESCRIPTION
FStoFile	Forwards CD-1.1 data from a framstore to the Classified System through the TGS.
FiletoFS	Receives CD-1.1 framestore data on the classified side that was sent through the TGS and writes the data to the classified framestore.
MLView	Displays the list of gaps identified by <i>FiletoFS</i> and provides support for writing the list to magnetic media.
FStoAlpha	Reads CD-1.1 data from a framestore, extracts encapsulated CD-1.0 data, and forwards the data to a CD-1.0 protocol data center.

Table 6. Major Data Parsing Components

COMPONENT	DESCRIPTION
DLParse	Reads CD-1.1 frames from a framestore, orders and decompresses the frames, and writes continuous waveform segments to diskloops, and corresponding descriptive records to the database.
update_interval	Produces interval table records in the database to show the time intervals for which data has been processed by DLParse.

4.1.2.1.1.2 Automatic Computer Software Configuration Item

The Automatic CSCI is composed of software for the automated geophysical processing of waveform data, which includes station processing, network processing, analysis support processing, post-analysis processing, analysis preparation, and waveform data quality statistical computation. The Station Processing function performs signal processing, makes measurements on signals and identifies the wave type of arrivals for all pipelines in the Classified Analysis Subsystem. By automatically associating arrivals in the Classified Analysis Subsystem, the Network Processing function processes arrivals from all network stations to define and locate events. The Analysis Support Processing function provides automated processing capabilities in support of interactive analysis. The Analysis Support Processing function performs beamforming and re-computation of signal processing measurements during analysis in the Classified Analysis Subsystem. The Post-analysis Processing function performs origin-based processing (including beamforming and noise amplitude measurements) and Maximum-Likelihood magnitude estimation. The Analysis Preparation function performs beamforming, hydroacoustic signal processing and association, and hydroacoustic azimuth estimation in preparation for analysis in the Classified Analysis Subsystem. Each function's major components are listed in Tables 7, 8, and 9, respectively.

Table 7. Major Station Processing Components

COMPONENT	DESCRIPTION
DFX	Principal time-series signal processing module. Performs all signal detection, signal measurement, and beamforming.
<i>StaPro</i>	Determines groups of phases detected at a seismic or hydroacoustic station and identifies phase type, based on features measured by <i>DFX</i> .

Table 8. Major Network Processing Components

COMPONENT	DESCRIPTION
<i>EvWarning</i>	Finds arrival associations by comparing new arrivals with pre-defined information for theoretical arrivals for a target location.
<i>GAassoc</i>	Uses grid data files generated by <i>GAcons</i> to associate arrivals, initially processed by the application <i>StaPro</i> , into event hypotheses.
<i>GAconflict</i>	Associates late secondary arrival to events formed by <i>GAassoc</i> and resolves inter-sector and time conflicts between arrivals associated with different events, which were created by separate instances of <i>GAassoc</i> .

Table 9. Major Analysis Support, Post-analysis and Analysis Preparation Components

COMPONENT	DESCRIPTION
DFX	Principal time-series signal processing module. Performs all signal detection, signal measurement, and beamforming.
<i>EvLoc</i>	Estimates event locations, m_b , M_s and Maximum-Likelihood magnitudes.
<i>HAE</i>	Groups hydroacoustic arrivals from a given array and estimates azimuth.

4.1.2.1.1.3 Interactive Computer Software Configuration Item

The Interactive CSCI is composed of software which analysts and evaluators use interactively to review and edit the Classified Analysis Subsystem's prior automatic and interactive processing stages' results. The major components for this CSCI are listed in Table 10.

Table 10. Major Interactive Processing Components

COMPONENT	DESCRIPTION
ArcShell	Translates the IPC message format used by <i>ARS</i> (via <i>libcoprocess</i>) to the Remote Procedure Call (RPC) message format used by ArcView.
<i>ARS</i>	Principal tool for interactive review of time-series data.
Discrim	Interactive program for evaluating and refining the quantitative discriminants applied to the classification of event type.
GAim	Interactive interface to the Global Association (GA) routines.

Table 10. Major Interactive Processing Components (Continued)

COMPONENT	DESCRIPTION
hydrodisplay	Principal tool for interactive analysis and evaluation of hydroacoustic data.
Map	Plots event locations in the <i>ARS</i> on a base map or image at a variety of scales. Also displays geographical information sent from other sources or the command interface window.
SpectraPlot	Performs spectral analysis on waveform data.
XfkDisplay	Provides interactive f-k analysis and display of three-component polarization data.
HART	Provides interactive review of hydroacoustic azimuths.

4.1.2.1.1.4 Distributed Computer Software Configuration Item

The Distributed CSCI is composed of software, which is used to support distributed pipeline processing in the Classified Analysis Subsystem, and to control and monitor processes in all subsystems. The Distributed Application Support (DACS) function provides a Tuxedo queue-based system for scheduling a sequence of automated processing tasks and a messaging-based system for enabling data sharing between interactive processing applications. The Control and Monitor functions provide graphical user interfaces (GUIs) to display the status of individual processes and the time interval based tasks they perform. The major components for these functions are listed in Tables 11 and 12, respectively.

Table 11. Major Distributed Application Control System Components

COMPONENT	DESCRIPTION
tuxpad	Starts, stops, and monitors automatic processes on the pipeline server.
Dman	Starts, stops, and monitors interactive processes on an Analyst/Evaluator Workstation.
Sequencer	Runs processes required for each time interval by sending messages to the appropriate tuxshells through Tuxedo.
Tuxshell	Manages a single client process required for a Tuxedo queue.
Dbserver	Updates the interval table in the database on behalf of a tuxshell.
Ticron	Creates time intervals to be processed based on clock time and submits the intervals to Tuxedo for processing.
Tin-server	Creates network processing time intervals based on completed station processing and submits the interval to Tuxedo for processing.
Tis-server	Creates station processing time intervals based on an available station waveform and submits the intervals to Tuxedo for processing.

Table 12. Major Control and Monitor Components

COMPONENT	DESCRIPTION
interval-router	Routes intervals created by tis-server to a specific Tuxedo queue.
Launch	Starts and monitors non-Tuxedo distributed processes.
WorkFlow	Monitoring tool. Displays the current status of time intervals; each interval is a separate process in the overall data flow; contains a variety of tools to monitor and control the interval status.

4.1.2.1.1.5 Monitoring Computer Software Configuration Item

The Monitoring CSCI provides tools for evaluating the US NDC Data Processing System performance. Monitoring includes the identification of any unusual characteristics in either raw or processed data and the comparison of automated and analyst-reviewed results. For example, unusually long delays in acquiring data are noted, as are events which automated processing misses. The major components for this CSCI are listed in Table 13.

Table 13. Major Monitoring Components

COMPONENT	DESCRIPTION
PerfMon	Performs system geophysical performance evaluation through interactive, background or command-line processing of data, and produces graphical reports.
BullComp	Compares seismic bulletins with one another.
ExAnComp	Compares the differences between an automated system event list and a bulletin reviewed by analysts and creates event summaries.
ConfigBrowse	Displays current station configuration, including detector channels, threshold settings, filters, array responses, and GA grid.

4.1.2.1.1.6 Tuning Computer Software Configuration Item

The Tuning CSCI provides the necessary utilities for testing specific automatic and interactive processing configurations capabilities to test, calibrate, visualize, and enhance the US NDC Data Processing System performance. This includes the ability to configure neural networks, Bayesian inference tables, and static grid files for use within StaPro and GA. A brief tutorial on how to configure and run GA is included. In addition, there is a utility program to generate synthetic event and detection data sets. Table 14 lists the Tuning CSCI's major components.

Table 14. Major Tuning Components

COMPONENT	DESCRIPTION
NNET	Retrieves specific training and testing data and calculating empirically-derived neural network weights used for initial wave type identification within StaPro.
<i>Bayes_convert</i>	Collection of SQL scripts and a utility program. Reads data from database and calculates empirical posterior probabilities used within StaPro for final regional phase identification.
<i>GAcons</i>	Builds a grid of pre-computed information for use by <i>GAassoc</i> , <i>GAconflict</i> , <i>GAim</i> , and <i>AGrid</i> .
<i>AGrid</i>	Displays a grid file created by <i>GAcons</i> .
<i>GA_tutorial</i>	Collection of SQL scripts. Demonstrate <i>GAcons</i> , <i>AGrid</i> , <i>GAassoc</i> , and <i>GAconflict</i> use using a predetermined small data set.
SynGen	Generates synthetic data sets consisting of detections and events with associated phases for testing GA, HAE and KB products.

4.1.2.1.1.7 Data Management Computer Software Configuration Item

The Data Management CSCI provides support for the creation and management of non-waveform data on the system. This includes US NDC database schema creation and management, as well as maintenance and archiving of alphanumeric data stored in the Oracle databases. It also includes management of configuration data and other static data needed to operate the system (e.g., application configuration files, travel-time tables, and yield tables). The major components for this CSCI are listed in Table 15.

The database instance, schema, and account structure are defined in the DBDD. The database schema is defined in the DBDD appendixes.

Table 15. Major Data Management Components

COMPONENT	DESCRIPTION
MigrateData	Copies alphanumeric results of geophysical processing from one database to another for archiving purposes.
Oracle scripts	Configuration files for the US NDC database.
<i>ArchiveData</i>	Writes alphanumeric results of geophysical processing to tape.
<i>ArchiveLongTerm</i>	Copies waveform data from disk loops into files in long-term storage and removes files from long-term storage whose age exceeds a specific value.
<i>ArchivePermanent</i>	Writes files from long-term storage to permanent storage digital linear tapes (DLTs).
<i>load_lookup</i>	Populates lookup account tables with data from configuration managed flat files.

4.1.2.1.1.8 Common Computer Software Configuration Item

The Common CSCI contains libraries shared by a wide variety of US NDC applications. They provide time-series monitoring, data handling and database access, application parameterization,

logging, messaging, and other support functions. These shared libraries are described in the remaining paragraphs of this section.

4.1.2.1.1.8.1 Time-series Monitoring Libraries

The Time-series Monitoring Libraries contain the underlying code for processing and displaying seismic waveform data. Applications are built using these mature libraries as building blocks. These libraries are listed in Table 16.

Table 16. Time-series Monitoring Libraries

COMPONENT	DESCRIPTION
<i>libAt</i>	AthenaTools Plotter Widget set. Contains widgets for two-dimensional X-Y scientific plots and line and bar charts. Available features include linear or logarithmic scaling, flexible text facilities, multiple plots per graph in selectable colors, and a user-controlled zoom/unzoom capability.
<i>libbeam</i>	Provides ability to compute beams from waveform data.
<i>libdataqc</i>	Provides quality control support for both data arrays and waveform structures.
<i>libfilter</i>	Provides filtering of data segments and covariance calculations.
<i>libfk</i>	Provides functions for computing spectra and fast Fourier transforms (fft).
<i>libGA</i>	Contains the main functions used by the GA group of programs that perform automatic association for network processing.
<i>libhydrom</i>	Computes hydroacoustic signal feature measurements and is used predominantly by the <i>DFX</i> application.
<i>libhydrot</i>	Contains functions for estimating the hydroacoustic travel time between two geographic points.
<i>libcgi</i>	Third-party DoE developed C++ library. Provides functions for accessing, manipulating and applying DoE KB travel-time correction surface data. US NDC products must load this library dynamically via the thin-shell (C to C++) interface library, <i>libcgi_shell</i> . These facilities are currently implemented in the US NDC processes, <i>ARS</i> , <i>EvLoc</i> , <i>Discrim</i> , <i>XjKDisplay</i> , <i>Gaim</i> , <i>GACons</i> , <i>GAassoc</i> , <i>GAconflict</i> , <i>StaPro</i> , <i>SynGen</i> and <i>DFX</i> . This library contains a large set of C++ functions.
<i>libcgi_shell</i>	SAIC-developed dynamic-load library. Provides functions for linking US NDC applications, written in the C programming language, with high-level KB C++ library, <i>libcgi</i> , functions required to access, manipulate and apply DoE KB travel-time correction surface data. US NDC products may load this library dynamically or, if not needed, may not load the library. This library provides the glue linking library <i>libcgi</i> with specific applications and the event location library <i>libloc</i> . Contains 11 C to C++ function interfaces.
<i>libloc</i>	Provides functions used for event location and related computations. Includes C interfaces for manipulating travel-time information (including various travel-time corrections), locating events, and predicting bounds on travel-time, slowness, and azimuth data. DoE travel-time correction surfaces can be accessed by dynamically loading the <i>libcgi</i> and <i>libcgi_shell</i> libraries as desired. Contains 60 C functions and 8 FORTRAN subroutines. No high-level access available to the FORTRAN subroutines.

Table 16. Time-series Monitoring Libraries (Continued)

COMPONENT	DESCRIPTION
<i>libLP</i>	Employs an algorithm whereby a path/period-dependent travel time may be calculated by specifying a latitude/longitude grid of surface wave velocities for LR and LQ phases. A ray is explicitly traced along a great circle path between the event and a station where each latitude/longitude grid cell is assigned its own velocity for a suite of periods. Given an input array of periods, returns an array of travel times.
<i>libmagn</i>	Provides functions for computing station and network magnitudes. Library components compute station magnitude using amplitude-distance correction tables. Both m_b and M_S estimates are available and network magnitudes can be computed as the station magnitudes mean or with maximum likelihood methods.
<i>libprob</i>	Contains general purpose functions to compute numerical values of a few functions used in statistical and probability analysis as well as functions that are specific to the computation of network probabilities of detection.
<i>libresponse</i>	Provides routines for retrieving the complex instrument response for a seismic instrument.
<i>libsigpolar</i>	Provides functions to extract attributes during particle-motion analysis. Functions used by signal processing programs.
<i>libspectra</i>	Provides functionality for computing power, amplitude, and phase spectra of a waveform. C interface is used by processes, including <i>ARS</i> , <i>DFX</i> , and <i>SpectraPlot</i> .
<i>libwav</i>	Provides functions for vector operations such as tapering, finding extreme, mean and variance, multiplication, division, addition, subtraction, and others.
<i>libwreq</i>	Contains programs to select intervals for waveform data retrieval.
<i>libXcss</i>	Contains application-specific X graphics widgets and utility functions that support those widgets. Widgets follow programming guidelines for X Toolkit widgets and use paradigms espoused therein, including X resources and <i>Staves()</i> and <i>Get Values()</i> , to determine operating parameters.
<i>libgeog</i>	Provides C functions for converting and manipulating geographic coordinate data used by many US NDC processes.
<i>libinterp</i>	Provides interpolation and extrapolation routines for manipulation of discrete bivariate data, in particular the travel-time and magnitude correction tables' distance and depth components. Many US NDC processes use this library.

4.1.2.1.1.8.2 Process Support and Inter-Process Communications Libraries

The Process Support and Inter-Process Communications Libraries contain the underlying code for managing aspects of processing that do not deal with waveform data. These libraries are listed in Table 17.

Table 17. Process Support and Inter-Process Communications Libraries

COMPONENT	DESCRIPTION
<i>libpar</i>	Provides two functions: retrieves runtime parameters from the environment, command line, and input files in a uniform way, provides a mechanism for sharing system-wide configuration information, and extracts parameters from arbitrary which is convenient for interpreting IPC messages.
<i>libscheme</i>	Implements the Scheme interpreter which is a LISP-like command interpreter. Scheme functions are used to provide high-level run-time configurability. Customization can be done on both a site-specific basis and on a personal user-specific basis.
<i>libstdtime</i>	Provides functions to perform time conversions.
<i>libtable</i>	Provides routines to manage the insertion, search, traversal, and deletion of data. The name promotes the notion of a generic data structure. Provides a consistent interface independent of underlying data structure implementation. Data structure used may be specified to be either linear linked lists, binary trees, or hash tables. Data being managed may be any user defined type.
<i>liblog</i>	Provides functions for writing the application logfiles.
<i>libipc</i>	Supports IPC between applications and Tuxedo DACS.

4.1.2.1.1.8.3 Data Handling and Database Related Libraries

The Data Handling and Database Related Libraries provide services relating to database interaction, reading and writing data, and converting between data types. These libraries are listed in Table 18.

Table 18. Data Handling and Database Related Libraries

COMPONENT	DESCRIPTION
<i>libconvert</i>	Converts between data types.
<i>libdb30qa</i>	Uncouples quality assurance (QA) services from the <i>libdb30</i> insert routines so that QA may be performed on data that is to be inserted with <code>gdi_add_ArrayStructs()</code> . The QA routines operate on data in arrays of predefined structures. There is a QA routine for each table in <i>libdb30</i> and <i>libdbims</i> . QA routines are called by an application independent of database insert function. Does not contain any database calls.
<i>libgdi</i>	Generic database interface (GDI) for Oracle, Sybase, and Illustra Relational Database Management System (RDBMS). Provides a common Application Program Interface (API) for database services with back-end drivers for each supported RDBMS. Provides a flexible mechanism for handling data from any query and in any form convenient to the application. Services are: <ul style="list-style-type: none"> • Multiple RDBMS connection management • Transaction management (tm) • Key counter assignment (arrival identifiers, origin identifiers, etc.) • Fetches from any query • Inserts into any table • Array Structs interface • Error handling • FORTRAN interfaces to all routines
<i>libgobj</i>	Define generic objects that tie to database.
<i>libwfm</i>	Provides high-level functions to access waveform data. Assumes waveform file pointers are stored in an Oracle database using tables in the CSS 3.0 format. Includes C and low-level FORTRAN interface routines. Used by several processes including <i>ARS</i> , <i>DFX</i> , and <i>SpectraPlot</i> .
<i>libwio</i>	Provides low-level file interface and data conversion for waveform files.

4.1.2.1.1.9 General Purpose Utilities

The General Purpose Utilities provide services relating time conversion, parameter file parsing, and process management. These utilities are listed in Table 19.

Table 19. General Purpose Utilities

COMPONENT	DESCRIPTION
etoh	Converts epoch time to human-readable time.
htoe	Converts human-readable time to epoch time.
jd	Returns current Julian date.
tevt	Full function time conversion utility.
readpar	Interprets values of parameters in configuration files.
kill_ops	Terminates processes owned by operations users.
OpsCrontab	Makes CRON entries for operational processes.

4.1.2.1.2 Non-developmental Items

Public domain software and COTS software comprise the NDIs. The following subsections describe these software items.

4.1.2.1.2.1 Public Software Non-developmental Items

The US NDC utilizes a number of applications, which are in the public domain. The US NDC does not support development of this software but the source code is kept under CM. The major public domain components are listed in Table 20.

Table 20. Major Public Non-developmental Item Components

COMPONENT	VERSION	SOURCE	DESCRIPTION
CLIPS	6	GHG	Expert system software
ghostscript	2.6.2	Aladdin Enterprises	PDF viewer
GMT	3.x	gmt.soest.hawaii.edu	Generic Mapping Tool
sac	10.6f	Lawrence Livermore National Laboratories (LLNL)	Geophysical functions
Scheme	2.3+	Paradigm Associates	Core for libscheme
TCP Wrapper	7.6	Solaris	See Section 3.3.2
Wcl	2.03	Siemens Nixdorf Informations Systeme AG	Widget Creation Library (WCL), X-widget GUI library
Xbae	4.5	www.xbae.syd.net.au	X-widget GUI library for matrix widgets

4.1.2.1.3 Commercial-Off-The-Shelf Software Non-developmental Items

The US NDC utilizes a number of applications, which are COTS products. CM tracks installed software product(s) version only. The major COTS software components used by the system are listed in Table 21.

Table 21. Major Commercial-Off-The-Shelf Software Components

COMPONENT	VERSION	VENDOR
ArcView	3.2	ESRI
Acrobat Reader	5.0.5	Adobe
ArcView Spatial Analyst	3.2	ESRI
ClearCase	4.2	Rational
ClearCase Distributed Defect Tracking System (DDTS)	4.1	Rational
Component Manager	2.2	Sun

Table 21. Major Commercial-Off-The-Shelf Software Components (Continued)

COMPONENT	VERSION	VENDOR
DiskSuite	4.2.1	Sun
FrameMaker	5.5.3	Adobe
Java 2 SDK	1.3.1	Sun
Navigator	4.79	Netscape
OpenSSL	0.9.4	OpenSSL Project
Oracle Server Enterprise Edition	8.1.7	ORACLE
PC-NFS	3.0	Sun
SAM-FS	3.5.0-33	Sun
Solaris OS	8 2/02	Sun
Splus	5.1	MathSoft
Sun WorkShop (Forte)	6 update 2	Sun
TGS software	1.2.2	Trusted Computer Solutions, Inc.
Terminal Server Firmware	3.6/8	Lantronix
Trusted Solaris OS	2.5.1 9/98	Sun
Tuxedo	8.0	BEA Systems, Inc.
Volume Manager	3.2	Sun/Veritas

4.1.2.2 Hardware Architecture

The system hardware is composed of thirteen HWCIs:

- Network Infrastructure HWCI
- Unclassified Data Acquisition HWCI
- Unclassified Archive HWCI
- Classified Analysis HWCI
- Classified Archive HWCI
- Analyst/Evaluator HWCI
- Training System HWCI
- Alt Network Infrastructure HWCI
- Alt Unclassified Data Acquisition HWCI
- Alt Unclassified Archive HWCI
- Alt Classified Analysis HWCI

- Alt Classified Archive HWCI
- Alt Analyst/Evaluator HWCI

Table 22 lists the HWCI and provides a brief description of each HWCI.

A sustainment capability is provided by duplicating the Operational Unclassified Data Acquisition and Classified Analysis HWCI hardware in a separate set of equipment. However, the main discussion of hardware architecture and all other system aspects focuses specifically on the operational components.

**Table 22. United States National Data Center
Hardware Configuration Items**

HWCI	DESCRIPTION
Network Infrastructure	Provides all internal data communications between subsystems. Provides workstation positions and network connectivity used for performing overall system, network, and database administration functions.
Unclassified Data Acquisition	Provides all data communications interfaces between the US NDC and external systems and networks. Hosts the processes that acquire unclassified data from external sites and forwards data to unclassified sites. Hosts the processes that forward data to the Classified System. Provides database server for data management.
Unclassified Archive	Provides storage for unclassified data to be archived. Hosts the processes that archive data. Provides database server for data management.
Classified Analysis	Hosts the processes that acquire classified data from external sites and from the Unclassified System. Hosts the processes that request retransmission of data from the Unclassified System. Hosts the processes that perform data processing. Provides database server for data management.
Classified Archive	Provides storage for classified data to be archived. Hosts the processes that archive data. Provides database server for data management.
Analyst/Evaluator	Provides workstation positions for analysts, evaluators, and operators.
Training System	Includes Instructor and Student Workstations, database server, printer, LAN, Uninterruptible Power Supply (UPS), and SmartClass 2000 for the Training System.
Alt Network Infrastructure	Provides all internal data communications between Alt US NDC Subsystems. Provides workstation positions and network connectivity used for performing overall system, network, and database administration functions at the Alt US NDC.
Alt Unclassified Data Acquisition	Provides all data communications interfaces between the Alt US NDC and external systems and networks. Hosts the processes that forward data to the Classified System. Provides database server for data management.
Alt Unclassified Archive	Provides storage for unclassified data to be archived at the Alt US NDC. Hosts the processes that archive data at the Alt US NDC. Provides database server for data management at the Alt US NDC.

**Table 22. United States National Data Center
Hardware Configuration Items (Continued)**

HWCI	DESCRIPTION
Alt Classified Analysis	Hosts the Alt processes that acquire classified data from external sites and from the Unclassified System. Hosts the processes that request retransmission of data from the Unclassified System. Hosts the processes that perform data processing. Provides database server for data management.
Alt Classified Archive	Provides storage for classified data to be archived at the Alt US NDC. Hosts the processes that archive data. Provides database server for data management.
Alt Analyst/Evaluator	Provides workstation positions for analysts, evaluators, and operators at the Alt US NDC.

The following subsections provide more detailed descriptions each HWCI's major components. See the SAIC-02/3000, *United States National Data Center (US NDC) Program Parts List (Phase 2)* for a complete list of all components.

4.1.2.2.1 Network Infrastructure Hardware Configuration Item

The Network Infrastructure HWCI consists of an unclassified and classified configuration, with the TGS providing the one-way link from the Unclassified Network to the Classified Network. The unclassified Network Infrastructure HWCI is shown in Figure 4 and the classified Network Infrastructure HWCI is shown in Figure 5. The Network Infrastructure HWCI provides all internal data communications between subsystems. It incorporates workstation positions used for performing system administration functions for the US NDC and it includes the Maintenance Network. In the Phase 1 Upgrade NDC System, a console server was used to connect to a video card in the system servers and the servers provided for direct connection of a mouse and keyboard. The Sun Fire servers do not support the direct connection of a monitor and keyboard/mouse. Instead, a Maintenance Network is used to connect to the maintenance ports (Ethernet and RS-232) on the Sun Fire System Controller. The storage hardware, except for the A5200 storage arrays, allows connection to a Maintenance Network via Ethernet and/or RS-232. These connections are shown in Figure 4 and Figure 5.

The Maintenance Network is implemented as a private network, reachable only by logging into the Unclassified System/Network Administration Workstation (opsuadm) or Classified System/Network Administration Workstation (opscadm). Due to security considerations regarding access to the Maintenance Network, routing is not turned on in the Network Administration Workstation, requiring logging into the Network Administration Workstations in order to access the Maintenance Networks. Further, access to the Network Administration Workstations are restricted solely to accounts created locally on the Network Administration Workstations. This is accomplished by not configuring the Network Administration Workstations as Network Information System (NIS) clients.

Table 23 lists the major Network Infrastructure HWCI components along with each component's number of instances and logical name. See Sections 4.1.2.2.1.1 through 4.1.2.2.1.4 for each component's details.

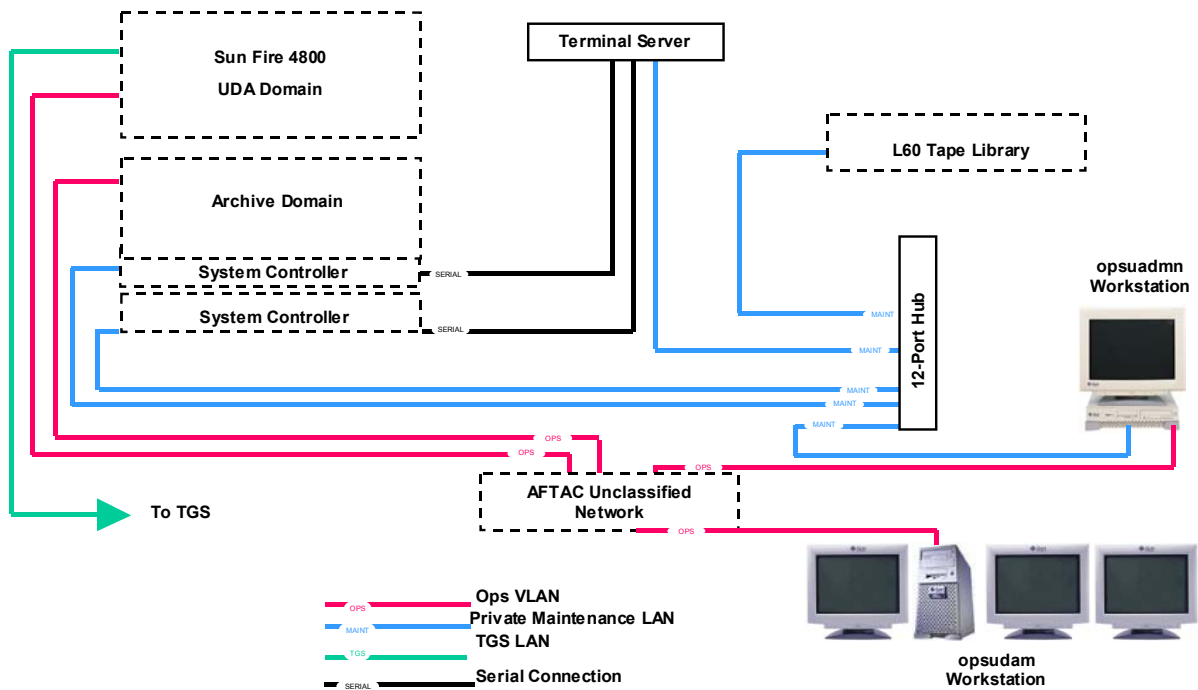


Figure 4. Unclassified Network Infrastructure Hardware Configuration Item

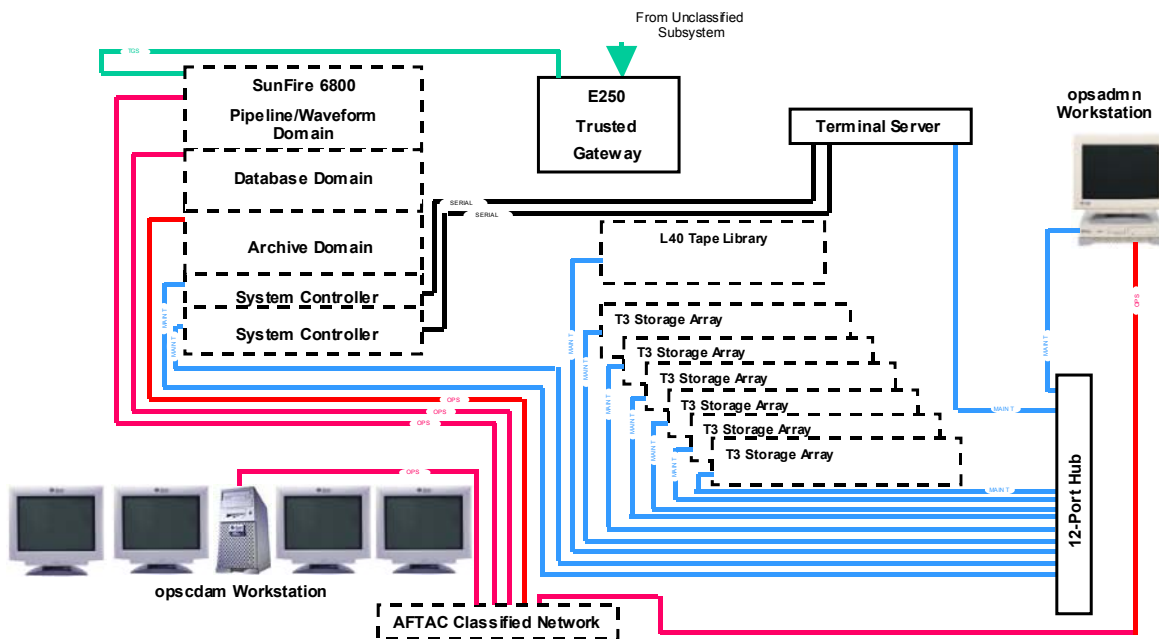


Figure 5. Classified Network Infrastructure Hardware Configuration Items

**Table 23. Network Infrastructure
Hardware Configuration Item Components**

COMPONENT NAME	QUANTITY	LOGICAL NAME(S)
Classified System/Network Administration Workstation	1	opscadm
Unclassified System/Network Administration Workstation	1	opsuadm
Classified Data Acquisition Manager Workstation	1	opscdam
Unclassified Data Acquisition Manager Workstation	1	opsudam
TGS	2	opstgs
Maintenance Hub	2	Not applicable (N/A)
Maintenance Terminal Server	2	N/A

4.1.2.2.1.1 Unclassified and Classified Central Network Switches

Network connectivity between the US NDC and external systems is provided by the AFTAC Network, which is not considered part of the US NDC. The US NDC servers connect to the AFTAC network using Gigabit Ethernet Fiber. US NDC workstations have 10/100Base-T interfaces and connect directly to the AFTAC Network or use fiber to connect through 10Base-FL/100Base-TX transceivers. The US NDC Classified and Unclassified Networks are implemented on the AFTAC Network as Virtual Local Area Networks (VLAN). When VLANs are established, the AFTAC Network hardware prevents direct transmission of Ethernet packets from any port of one VLAN to any port of another VLAN. Each VLAN functions as a physically isolated Ethernet segment. Any flow of information from one VLAN to another must be accomplished by an external routing device.

The data communications interface to unclassified external systems is accomplished through an external router (the AFTAC firewall). The external router provides data circuit links to all the external networks from which the US NDC receives raw data and to which the US NDC forwards raw data. The external router (firewall) provides a security barrier between the US NDC and any potentially hostile force attempting to gain access to the US NDC by way of the external data circuits.

The AFTAC firewall establishes three security zones on the Unclassified System: an external zone where all external interfaces are connected, a demilitarized zone (DMZ) where systems such as web servers, which provide US NDC-generated information to external users are connected, and the internal zone where the Unclassified Systems are connected. Other non-US NDC AFTAC systems, such as the ADSN and the Directorate of Nuclear Treaty Monitoring (TT) LAN, are also connected to the internal zone.

4.1.2.2.1.2 Unclassified and Classified System/Network Administration Workstations

The Network Administration Workstations provide the resources to perform the system, network, and database administration duties on the US NDC Unclassified and Classified Systems. Most database administration functions are performed from other non-US NDC workstations that have network connectivity to the US NDC.

The Unclassified and Classified System/Network Administration Workstations (opsuadm and opscadm) are Sun Ultra 5 Workstations equipped with 384 MB memory and a 4.3 GB internal disk. The workstations include two Ethernet interfaces, with one interface providing connectivity to the AFTAC network and the other interface providing connectivity to Maintenance Networks. With the exception of shell scripts, all the software installed on these workstations is COTS.

The Unclassified and Classified Ultra 5 Network Administration Workstations can be configured with up to 512 MB of memory and a 20 GB internal disk drive. As configured, the Network Administration Workstations use one of the three peripheral card slots in the Ultra 5 Workstation and the other two peripheral slots are available for expansion.

4.1.2.2.1.3 Trusted Gateway System

The TGS consists of a Sun E250 server running Trusted Solaris 2.5.1 and TGS software. The TGS software provides for configuring and sharing file systems as read/write to the US NDC Unclassified System and as read-only to the US NDC Classified System, thus providing a secure low-to-high only transfer mechanism. In addition to providing the file transfer capability, the TGS is configured to perform virus scanning on any non-waveform files transferred from the Unclassified System to the Classified System.

The TGS E250 server is configured with two 400 MHz processors, 2 GB of memory, four internal 36 GB disk drives, a 4 mm tape drive, and DVD drive. This is the maximum internal memory and processor configuration supported by the E250. Two internal 36 GB disk drives can be added and additional storage can be provided using interface cards in the two unused peripheral card slots in the E250. If additional TGS processing capability is needed in the future, the E250 server can be replaced with a more powerful server that runs the Trusted Solaris 2.5.1 OS, up to and including the Sun E6500 server, which can be configured with up to thirty 464 MHz processors and 60 GB of memory.

4.1.2.2.1.4 Unclassified/Classified Data Acquisition Manager Workstations

The udam and cdam Workstations provide the capability to monitor and control real-time acquisition status and archiving of waveform data from external sources. udam and cdam Workstations operate identically. The workstation operator verifies normal operations for these functions as well as detects reduced capabilities due to abnormal conditions, such as interruptions in external communications. The workstation operator also selectively starts and stops individual data acquisition processes on specific processors, thereby effecting total control over receiving, forwarding, and archiving functions.

The udam and cdam Workstations are Sun Ultra 10 workstations, each configured with a 440 MHz processor, 1 GB of memory, internal 20 GB hard drive, one Elite 3D-m6 graphics card, two PGX32 graphics cards, and three or four 21-inch monitors. This workstation is expandable with an additional 20 GB internal drive and there are two peripheral card slots for additional expansion.

The cdam Workstation has a fourth monitor which allows the displaying of Sun Management Center status. Sun Management Center agents run on each domain configured in the classified Sun Fire servers (both the US NDC and the Alt US NDC Sun Fire servers). The Sun Management Center allows remote Sun Fire servers monitoring and control.

For the unclassified Sun Fire servers, Sun Management Center status is displayed on an additional udam Workstation.

4.1.2.2.2 Unclassified Data Acquisition Hardware Configuration Items

Figure 6 shows a US NDC server hardware overview. The Data Acquisition Subsystem Domain depicted in the figure represents the Unclassified Data Acquisition HWCI, which is shown in more detail in Figure 7.

The Unclassified Data Acquisition HWCI acquires data from remote, unclassified sites, forwards necessary data to external customers, and forwards data to the Classified System.

Table 24 lists the major Unclassified Data Acquisition HWCI components along with each component's number of instances and logical name. See the following subsections for each component's details.

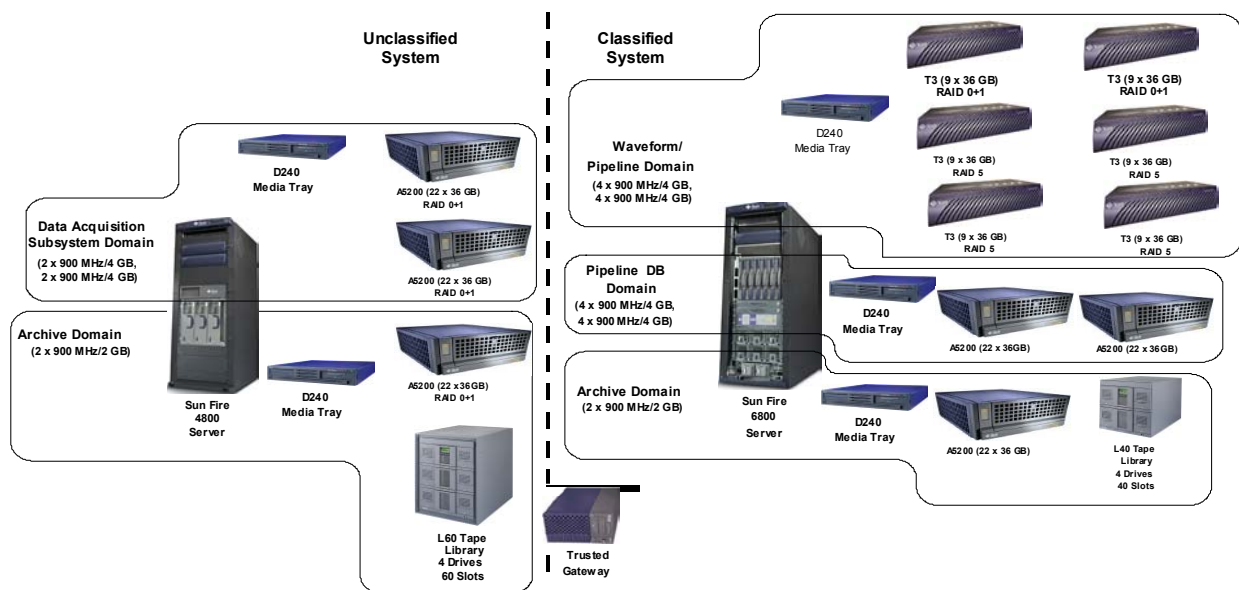


Figure 6. Server Hardware Architecture

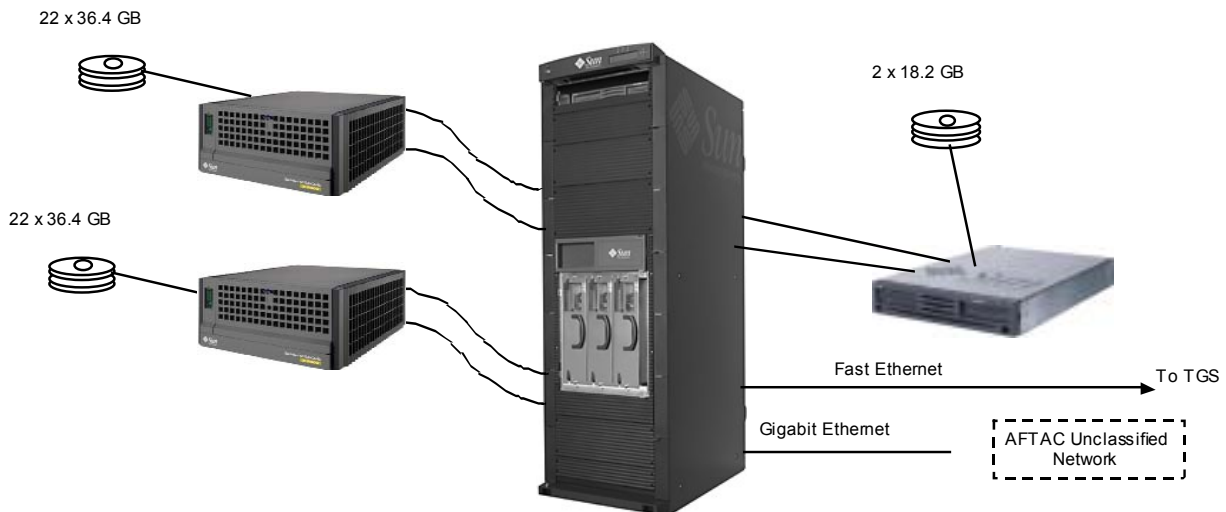


Figure 7. Unclassified Data Acquisition Hardware Configuration Item

Table 24. Unclassified Data Acquisition Hardware Configuration Item Components

COMPONENT NAME	QUANTITY	LOGICAL NAME(S)
Diskloop Server/Sun Fire 4800 Data Acquisition Subsystem Domain	1	opsda
A5200 Storage Array	2	N/A
D240 Media Tray	1	N/A

4.1.2.2.2.1 Diskloop Server

The Diskloop Server performs all Unclassified Data Acquisition functions. These functions include receiving waveform data, collecting the data in the disk loops, forwarding data, hosting an Oracle database, and hosting the functions previously hosted by ndcadmin on the US NDC Phase 1 Upgrade System. The Oracle database provides data acquisition management tables and the waveform reference table. The Data Acquisition Subsystem Domain in the Sun Fire 4800 server is configured on two system boards, with each board having two 900 MHz UltraSPARC III central processing unit (CPU) modules and 4 GB of memory (four CPUs and 8 GB memory total). Storage for the Data Acquisition Subsystem Domain is comprised of an 18.2 GB Small Computer System Interface (SCSI) disk drive and mirror, one DVD drive, and one Digital Data Storage (DDS)-4 tape drive (all contained in the D240 media tray), plus two A5200 storage arrays, each with twenty-two 36.4 GB fiber-channel disk drives. Boot disk mirroring is controlled by Solstice DiskSuite software operating at Redundant Array of Independent Disks (RAID) Level 1. Disks in the A5200 storage arrays are controlled by Veritas Volume Manager. The arrays are configured as a mirrored pair, where loss of one complete A5200 does not interrupt processing on the system. The A5200 arrays are configured with hot

spare disks so that if a disk drive fails, the system automatically configures the hot spare to replace the failed disk with no administrator action.

The Data Acquisition Subsystem Domain connects to the AFTAC network using a fiber Gigabit Ethernet interface. The Data Acquisition Subsystem Domain also connects to the TGS using a Fast Ethernet connection and the Network File Server (NFS) protocol.

The Data Acquisition Subsystem Domain in the Sun Fire 4800 can be expanded to include eight processors and 64 GB of memory. As configured, the Data Acquisition Subsystem Domain has one unused peripheral card slot which can be used for expansion. In addition, the A5200 storage arrays allow for daisy chaining, which allows, as a minimum, doubling of the amount of external disk storage configured in the Data Acquisition Subsystem Domain.

4.1.2.2.2.2 Unclassified Data Acquisition Hardware Configuration Item Sustainment Duplication

The Unclassified Data Acquisition HWCI is duplicated to provide a sustainment capability identical to the Operational system (only the boot disk in the Sustainment System server is mirrored on the Sustainment Diskloop Server; the other disks are not mirrored). The Sustainment System unclassified data acquisition design takes advantage of data acquisition software components' modularity and automatic forwarding capabilities. New instances of data acquisition modules can be replicated on the Sustainment Diskloop Server. The operational instances of data acquisition can also forward live data to the test configuration of data acquisition running on the Sustainment system. Data acquisition can be configured so that live operational data or data from the Sustainment machines can be forwarded to the Sustainment pipeline as desired.

Since the Sustainment System uses the same Sun Fire 4800 as the Operational System, the Sustainment System can be expanded to the same configuration as the Operational System.

4.1.2.2.3 Unclassified Archive Hardware Configuration Item

The Unclassified Archive HWCI, shown in Figure 8, provides long-term storage of data received by the Unclassified Data Acquisition Subsystem. Table 25 lists the major Unclassified Archive HWCI components along with each component's number of instances and logical name. See Section 4.1.2.2.3.1 for each component's details.

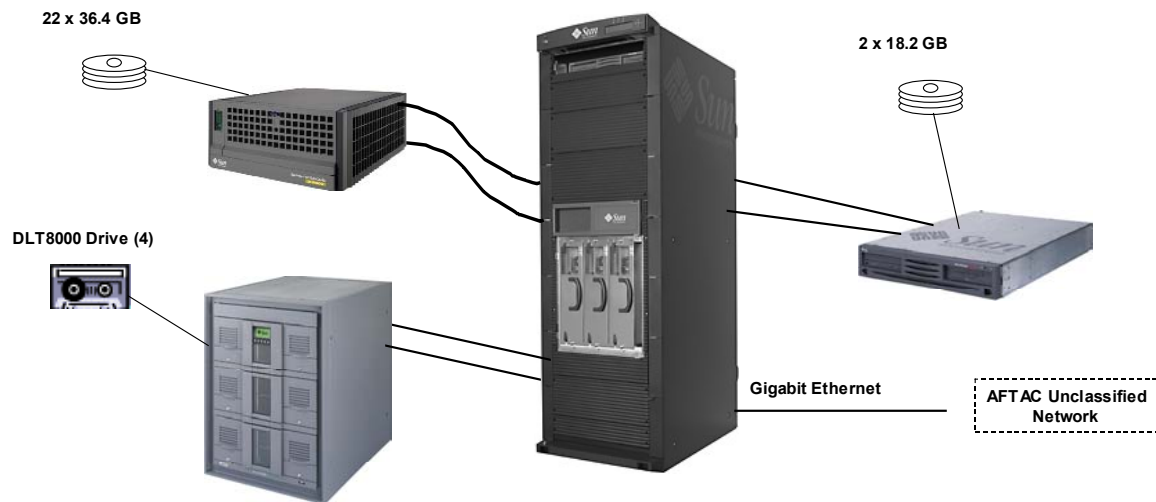


Figure 8. Unclassified Archive Hardware Configuration Item

Table 25. Unclassified Archive Hardware Configuration Item Components

COMPONENT NAME	QUANTITY	LOGICAL NAME(S)
Unclassified Archive/Database Server/Sun Fire 4800 Archive Domain	1	opsuarch
A5200 Storage Array	1	N/A
D240 Media Tray	1	N/A
L60 Tape Library	1	N/A

4.1.2.2.3.1 Unclassified Archive/Database Server

The Unclassified Archive/Database Server is implemented as the Archive Domain in the Sun Fire 4800 server (the second domain in the Sun Fire 4800 shown in Figure 6). The Archive Domain is configured with one system board within the Sun Fire 4800, with two 900 MHz UltraSPARC III CPU modules and 2 GB of memory. Storage for the Archive Domain is comprised of an 18.2 GB SCSI disk drive and mirror, one DVD drive, one DDS-4 tape drive, an L60 Tape Library, and a A5200 storage array with twenty-two 36.4 GB fiber-channel disk drives. Just as in the Data Acquisition Subsystem Domain, boot disk mirroring in the Archive Domain is controlled by Solstice DiskSuite operating at RAID 1. Disks in the A5200 storage array are controlled by Veritas Volume Manager with the disks in a mirrored configuration. The A5200 array is configured with hot spare disks so that if a disk drive fails, the system automatically configures a hot spare to replace the failed disk with no administrator action.

The L60 Tape Library is used for storing 180 days of unclassified waveform data. The library is connected to the Archive Domain through two UltraSCSI interfaces. Four DLT8000 tape drives are installed in the L60 Library and the library can hold sixty 40-80 GB DLTs, providing a near realtime storage capacity of at least 2,400 GB.

The Archive Domain in the Sun Fire 4800 can be expanded to include four processors and 32 GB of memory. As configured, the Archive Domain has two unused peripheral card slots which can be used for expansion. In addition, the A5200 storage array allow for daisy chaining which allows, as a minimum, doubling the amount of external disk storage configured in the Archive Domain.

4.1.2.2.4 Classified Analysis Hardware Configuration Item

The Classified Analysis HWCI (see Figure 9) hosts the Classified Data Acquisition and Automatic Processing functions. The Classified Analysis HWCI is implemented as two domains in the Sun Fire 6800 server (see Figure 6). Table 26 lists the major Classified Analysis HWCI components along with each component's number of instances and logical name. See the following subsections for each component's details.

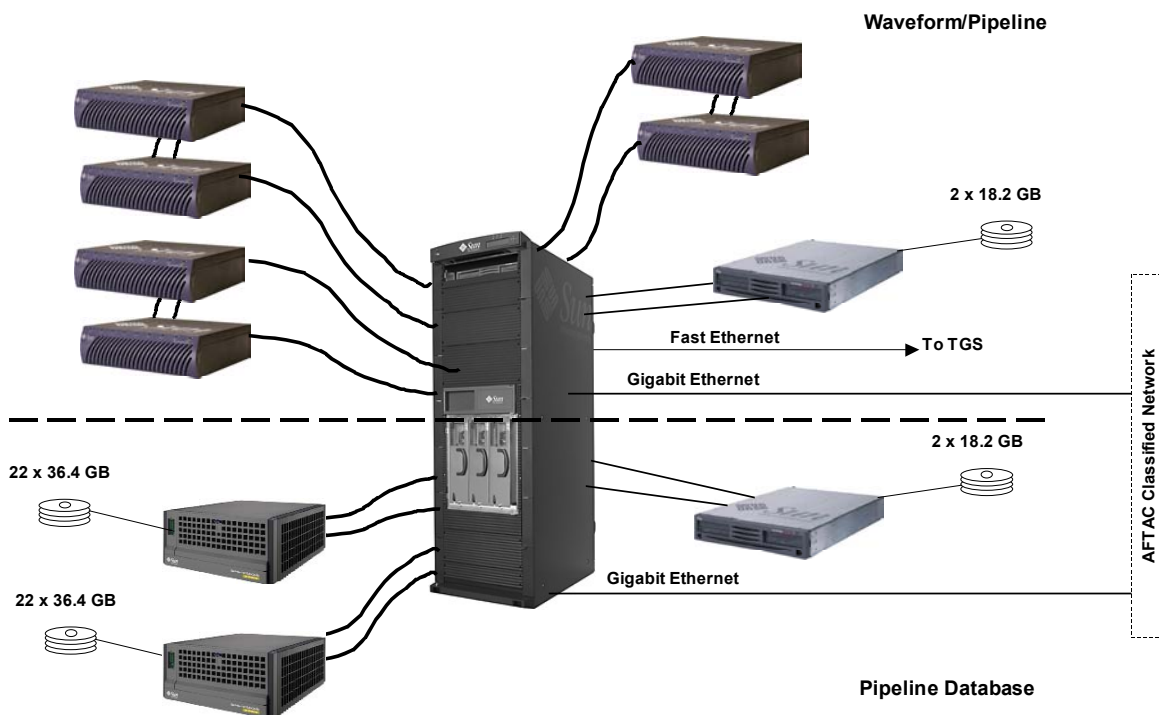


Figure 9. Classified Analysis Hardware Configuration Item

Table 26. Classified Analysis Hardware Configuration Item Components

COMPONENT NAME	QUANTITY	LOGICAL NAME(S)
Waveform/Pipeline Server/Sun Fire 6800 Waveform/Pipeline Domain	1	opspipe
Pipeline Database Server/Sun Fire 6800 Pipeline Database Domain	1	opsdbs
D240 Media Tray	2	N/A
T3 Storage Array	6	N/A
A5200 Storage Tray	2	N/A

4.1.2.2.4.1 Waveform/Pipeline Server

The Waveform/Pipeline Server is implemented as the Waveform/Pipeline Domain in a Sun Fire 6800 Server (one of three domains configured in the Sun Fire 6800). The Waveform/Pipeline Domain is configured with two system boards within the Sun Fire 6800, each with four 900 MHz UltraSPARC III CPU modules and 4 GB of memory (8 CPUs and 8 GB memory total). Storage for the Waveform/Pipeline Domain is comprised of an 18.2 GB SCSI disk drive and mirror, one DVD drive, and one DDS-4 tape drive, plus six T3 storage arrays. Each T3 includes nine 36.4 GB fiber-channel disk drives and a hardware RAID controller with 1 GB of cache. The T3 arrays are configured in three pairs, which provides redundant fiber-channel access to the drives in each T3 array. Four T3 arrays (two pairs) are configured as RAID 5, with a hot spare drive configured in each T3 array. This RAID 5 capability provides storage for 45 days of raw and derived waveforms.

Two additional T3 arrays are configured as a pair in RAID 5 (including hot spare drive in each T3). One of these T3 storage arrays is used for the framestore, and the other is used for log files, home directories, audit files, etc. All T3 storage is configured using Veritas Volume Manager, while the boot disk drive is mirrored using Solstice DiskSuite. The Waveform/Pipeline Domain connects to the AFTAC network through a fiber Gigabit Ethernet interface. This Domain also includes a Fast Ethernet interface to access the TGS using the NFS.

The Waveform Pipeline Domain in the Sun Fire 6800 can be expanded to include 64 GB of memory. In addition, the Sun Fire 6800 has one empty system board slot which can be used to add up to four more processors and 32 GB of memory to the Waveform/Pipeline Domain. As configured, the Waveform/Pipeline Domain has seven unused peripheral card slots which can be used for expansion. This, for example, allows the addition of six more T3 storage arrays which doubles the amount of disk storage in the Waveform/Pipeline Domain.

4.1.2.2.4.2 Pipeline Database Server

The Pipeline Database Server is implemented as one of three domains on the Sun Fire 6800 server. The Pipeline Database Domain uses two system boards within the Sun Fire 6800, with each board having four 900 MHz UltraSPARC III CPU modules and 4 GB of memory. An 18.2 GB boot disk and mirror, DVD drive and DDS-4 tape drive are contained in the D240 Media Tray. The boot disk and mirror are configured as RAID 1, using Solstice

DiskSuite. Oracle data files reside on the A5200 storage arrays, which are configured with twenty-two 36.4 GB disk drives. The drives are configured as RAID 1+0 (striped mirrors) using Veritas Volume Manager. Data mirroring is done across the A5200 storage arrays so that even with the loss of an entire array, the system continues to operate normally. Hot spare drives are also configured in the storage arrays to allow automatic replacement of a failed or failing disk drive. Each A5200 storage array is accessed through two separate fiber-channel interfaces.

The Pipeline Database Domain on the Sun Fire 6800 can be expanded to include 64 GB or memory. In addition, the Sun Fire 6800 has one empty system board slot which can be used to add up to four more processors and 32 GB of memory to the Waveform/Pipeline Domain. As configured, the Waveform/Pipeline Domain has one unused peripheral card slot which can be used for expansion. In addition, the A5200 arrays allow for daisy chaining, which allows for, as a minimum, doubling of the amount of external disk storage configured in the Pipeline Database Domain.

4.1.2.2.4.3 Classified Analysis Hardware Configuration Item Sustainment Duplication

The Sustainment System Classified Analysis HWCI is identical to the Operational System Classified Analysis HWCI, with the exception of the storage capacity. Disk storage that is mirrored for the Operational System Classified Analysis HWCI, is not mirrored in the Sustainment System Classified Analysis HWCI, with the exception of the boot disk (which is mirrored). The Classified Sustainment System has 22 days of storage.

Since the Sustainment System uses the same Sun Fire 6800 as the Operational System, the Sustainment System can be expanded to the same configuration as the Operational System.

4.1.2.2.5 Classified Archive Hardware Configuration Item

The Classified Archive HWCI, shown in Figure 6 as the Classified Archive Domain, provides long-term and permanent storage of the data received by the Classified Data Acquisition Subsystem and processed in the Classified Analysis Subsystem. Figure 10 shows the Classified Archive HWCI in more detail. Table 27 lists the major Classified Archive HWCI components along with each component's number of instances logical name. See the following subsections for each component's details.

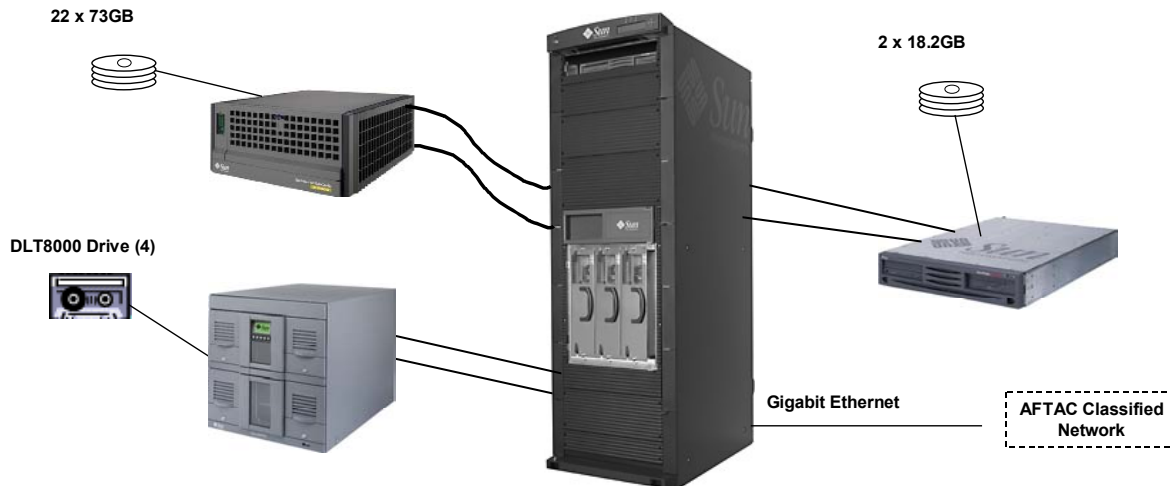


Figure 10. Classified Archive Hardware Configuration Item

Table 27. Classified Archive Hardware Configuration Item Components

COMPONENT NAME	QUANTITY	LOGICAL NAME(S)
Classified Archive/Database Server/Sun Fire 6800 Archive Domain	1	opsearch
A5200 Storage Array	1	N/A
D240 Media Tray	1	N/A
L40 Tape Library	1	N/A

4.1.2.2.5.1 Classified Archive/Database Server

The Classified Archive/Database Server is implemented as the Archive Domain in the Sun Fire 6800 server. The Archive Domain is configured on one system board within the Sun Fire 6800, with two 900 MHz UltraSPARC III CPU modules and 2 GB of memory. Storage for the Archive Domain is comprised of an 18.2 GB SCSI disk drive and mirror, one DVD drive, and one DDS-4 tape drive (all contained in the D240 media tray), an L40 Tape Library, plus an A5200 storage array with twenty-two 73 GB fiber-channel disk drives. Boot disk mirroring in the D240 is controlled by Solstice DiskSuite operating at RAID 1. Disks in the A5200 storage array are controlled by Veritas Volume Manager. The A5200 is configured with spare disks so that if a disk drive fails, the system automatically configures the hot spare to replace the failed disk drive.

The L40 Tape Library is used to permanently archive waveform data using the SAM-FS Storage Migrator software. The library is connected to the Archive Domain through two UltraSCSI interfaces. Four DLT8000 tape drives are installed in the L40 Library and the library can hold up to forty 40-80 GB DLTs. One tape library tape drive backs up waveform data, while the

others back up Oracle databases (including the Oracle database on the Pipeline Database Server) and to archive alphanumeric data in a flat file format.

The Archive Domain is connected to the AFTAC network using a Gigabit Ethernet fiber interface.

The Archive Domain on the Sun Fire 6800 can be expanded to include four more processors and 32 GB of memory. As configured, the Archive Domain has two unused peripheral card slots which can be used for expansion. In addition, the A5200 array allow for daisy chaining, which allows for, as a minimum, doubling of the amount of external disk storage configured in the Archive Domain.

4.1.2.2.6 Analyst/Evaluator Hardware Configuration Item

The Analyst/Evaluator HWCI (see Figure 11) provides interactive processing capabilities. Table 28 lists the major Analyst/Evaluator HWCI components along with each component's number of instances logical name. See the following subsections for each component's details.

4.1.2.2.6.1 Analyst, Evaluator and System Operations Manager Workstations

The Analyst/Evaluator and System Operations Manager (SOM) Workstations are identically configured Sun Ultra 10 workstations with dual 21-inch monitors. The AFTAC Operations Center operational analysis area contains six workstations for operations analyst use. The evaluations area contains seven workstations. The System Control area contains one SOM Workstation. Each workstation has a single 440 MHz UltraSPARC II processor with 1 GB of main memory and a 20 GB internal hard disk. The system disk holds the Solaris OS software. The dual monitors, driven from PGX32 graphics cards, provide 1280x1024 resolution and 24-bit color on both monitors.

Analyst Workstations can access either the operational or sustainment processing stream. In operational practice, the operational area workstations attach to whichever pipeline is designated as ops. Analyst Workstations can attach to the test pipeline or quickly reconfigure to attach to the ops pipeline for ops/test comparisons or other testing purposes as required. Alternate Oracle database identifiers determine which database [Test Database (TESTDB) or Operations Database (OPSDB)] is accessed. Database choice determines which waveform file system is used, based on **wfdisc** table contents.

The Analyst/Evaluator HWCI contains two laser printers, a color laser printer installed in the evaluation area and a black and white laser printer installed in the AFTAC Operations Center.

The Analyst/Evaluator and SOM Workstations can be expanded with an additional 20 GB hard drive and there are two available peripheral card slots for expansion as well as an unused UltraSPARC port architecture graphics slot.

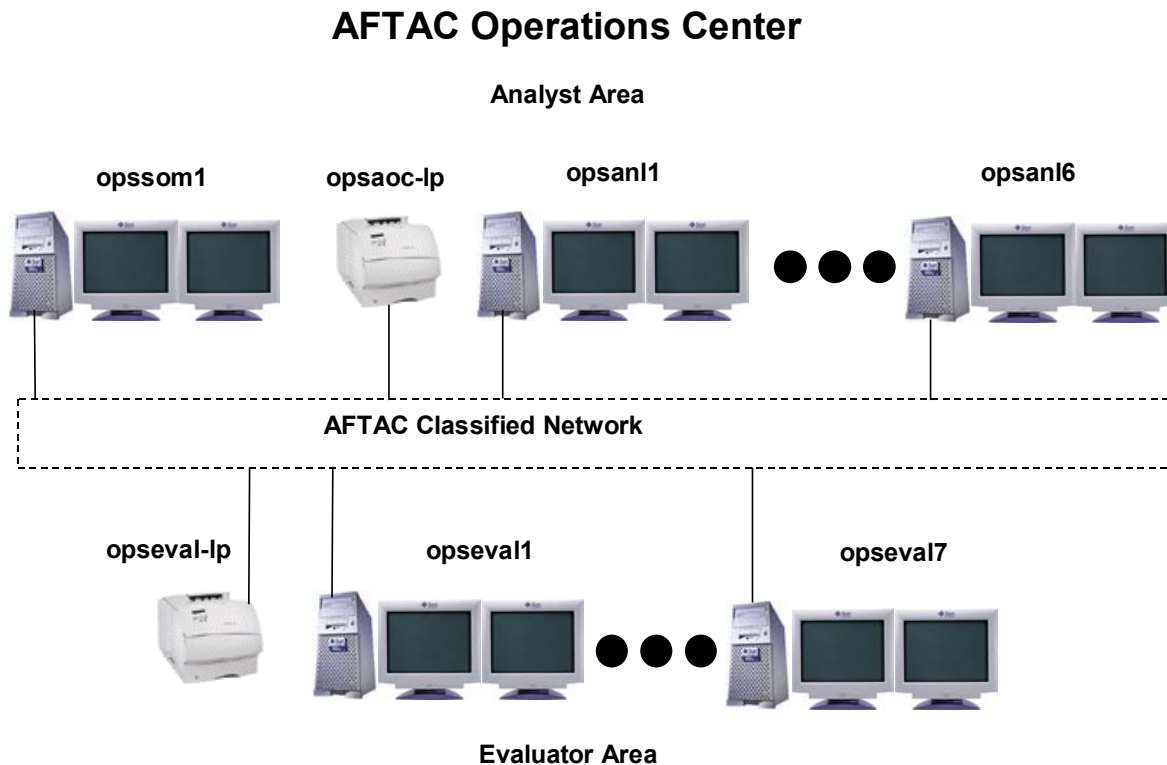


Figure 11. Analyst/Evaluator Hardware Configuration Item

Table 28. Analyst/Evaluator Hardware Configuration Item Components

COMPONENT NAME	QUANTITY	LOGICAL NAME(S)
Analyst Workstation	6	opsanl[1-6]
Evaluator Workstation	7	opseval[1-7]
SOM Workstation	1	opssom1
Color Printer	1	opseval-lp
B/W Printer	1	opsaoc-lp

4.1.2.2.7 Training System Hardware Configuration Item

The Training System HWCI depicted in Figure 12 duplicates the US NDC Phase 2 Operational System analysis capabilities. Table 29 lists the major Training System HWCI components along with each component's number of instances component logical name. See the following subsections for each component's details.

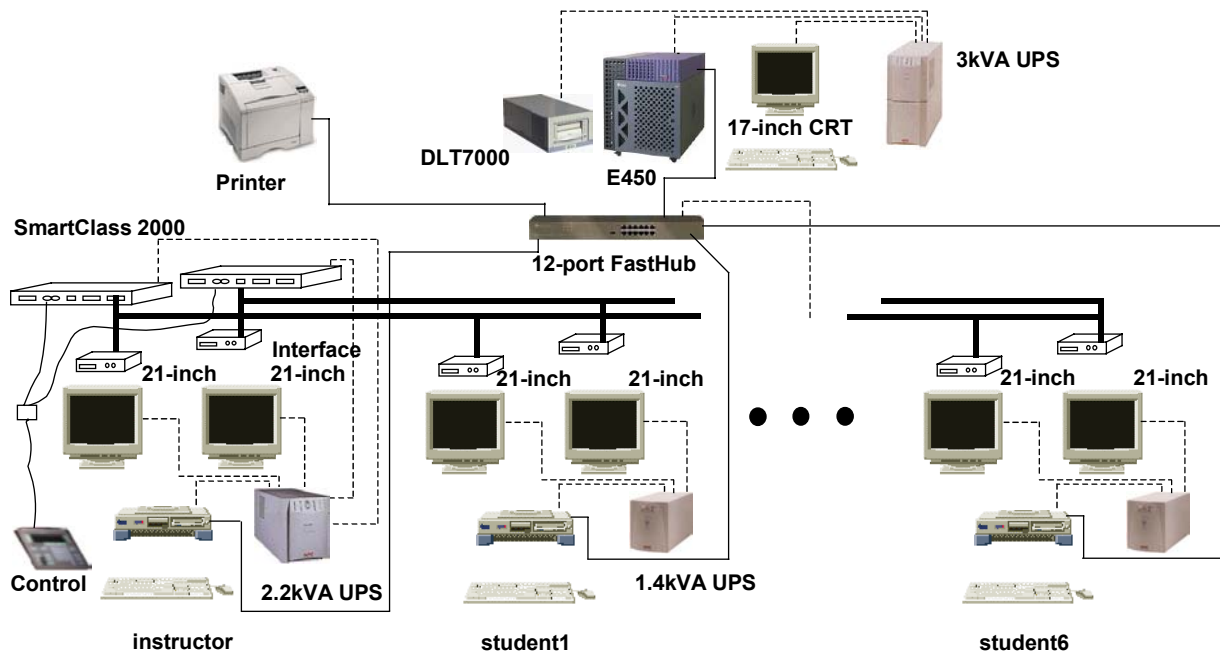


Figure 12. Training System Hardware Configuration Item

Table 29. Training System Hardware Configuration Item Components

COMPONENT NAME	QUANTITY	LOGICAL NAME(S)
Instructor Workstation	1	instructor
Student Workstations	6	student[1-6]
Database Server	1	Database
Printer (BW/Color)	1	Printer
Display Projection	1	SmartClass 2000
Network	1	LAN
Power	8	UPS

4.1.2.2.7.1 Instructor Workstation

The Instructor Workstation is configured the same as the Operational Analyst, Evaluator and SOM Workstations [Sun Ultra 10 workstation, 440 MHz processor, 1 GB memory, 20 GB internal hard disk, two PGX32 graphics cards, two 21-inch monitors]. The Instructor Workstation provides instructor access to all analysis, maintenance, and computer-assisted training functions. Maintenance functions include managing student accounts and processes, preparing analysis data, and setting up database accounts for students. The use of a computer-assisted training tool allows display of selected Instructor Workstation displays on Student

Workstations and display of selected Student Workstations displays on the Instructor Workstation.

The Instructor Workstation supports the same configuration expansion as the Analyst/Evaluator and SOM Workstations.

4.1.2.2.7.2 Student Workstations

The Student Workstations provide students the software interfaces and processes to support training on US NDC analyst functions. The Student Workstations are the same Sun Ultra 10 workstation configuration as the Instructor Workstation.

The Student Workstations support the same configuration expansion as the Analyst/Evaluator/SOM and Instructor Workstations.

4.1.2.2.7.3 Database Server

The Training System Database Server is a Sun Enterprise 450, with two 480 MHz/8 MB cache UltraSPARC II CPU modules and 2 GB main memory. The database server hosts student and instructor US NDC Oracle database tables and user accounts. It also contains the storage capacity necessary for waveforms and alphanumeric data imported from the US NDC Operational System and alphanumeric data generated by students during training. To load alphanumeric and waveform data from the US NDC Operational System and to perform routine Training System backups, a DLT tape drive is connected to the database server.

The E450 is configured with twenty 36.4 GB hard disks, with the disks in RAID configurations using Solstice DiskSuite. Two internal disks are configured as a mirrored pair for the boot drive. Six disks are configured as three mirrored pairs for Oracle, providing approximately 105 GB of storage. Two disks are configured as a mirrored pair for storing beams generated by the students during class, providing approximately 35 GB of storage. Nine disks are configured in a software RAID 5 configuration to accommodate waveform data to be used during classes, and one disk is configured as a hot spare for the RAID 5 disks. The RAID 5 configuration provides approximately 280 GB of formatted storage.

The E450 Database Server can be expanded to four 480 MHz processors and 4 GB of memory. While the E450 Database Server internal disk storage capacity can not be increased, seven unused peripheral card slots allow the addition of more than 22,000 GB of external storage.

4.1.2.2.7.4 Printer

The Training System printer is a Lexmark C710n laser printer, which produces high quality hardcopy and graphics in both black and white and color. The printer supports PostScript and includes a standard Ethernet interface.

4.1.2.2.7.5 Display Projection

The Training System HWCI includes a SmartClass 2000 which allows instructor control of display projection from both Instructor Workstation monitors to any or all Student Workstation monitors and the ability to view the display on any Student Workstation monitors from the Instructor Workstation monitors.

4.1.2.2.7.6 Network

The Training System HWCI includes a 12-port Cisco FastHub 400 10/100 Series hub for network connectivity between the workstations, server, and printer. The Training System is installed as a stand-alone system with no external network connectivity.

4.1.2.2.7.7 Power

All Training System HWCI hardware, except the printer, are configured to run from UPSs. The server and DLT 7000 tape drive are connected to an APC3 kilovoltampere (kVA) UPS. The Instructor Workstation and SmartClass 2000 hardware are connected to a 2.2kVA UPS. Each Student Workstation is connected to an APC 1.4kVA UPS. In addition, the Cisco network hub is connected to the UPS used for Student Workstation 3. The printer is connected to power through a surge suppression power strip.

In the event of a commercial power outage, the Training System HWCI UPS provides a nominal run time of 30 minutes. The APC UPSs have a typical transfer time of .002 seconds and maximum transfer time of .004 seconds, which is fast enough to allow the machines to continue normal operation if commercial power is lost. The Instructor and Student Workstations are configured to automatically begin a normal shutdown process after commercial power is down for more than 25 minutes; this shutdown typically takes less than 5 minutes. The Database Server is configured to begin shutting down after commercial power is down for more than 30 minutes; the server typically shuts down in less than 5 minutes.

4.1.2.2.8 Alternate Network Infrastructure Hardware Configuration Item

The Alt Network Infrastructure HWCI is similar to the Network Infrastructure HWCI and provides the same functionality for the Alt US NDC as the Network Infrastructure HWCI provides for the US NDC. Figure 13 and Figure 14 show the Alt Network Infrastructure HWCI unclassified and classified portions, respectively.

The Alt Network Infrastructure HWCI includes the Alternate Unclassified Administration (ALTUADMN) Workstation (for the Unclassified Alt Maintenance Network) and the Alternate Classified Administration (ALTCADMN) Workstation (for the Classified Alt Maintenance Network).

Table 30 lists the major Alt Network Infrastructure HWCI components, along with each component's number of instances and logical name. The details of each component are, except

as noted below, the same as those of the Network Infrastructure HWCI described in Sections 4.1.2.2.1.1 through 4.1.2.2.1.4.

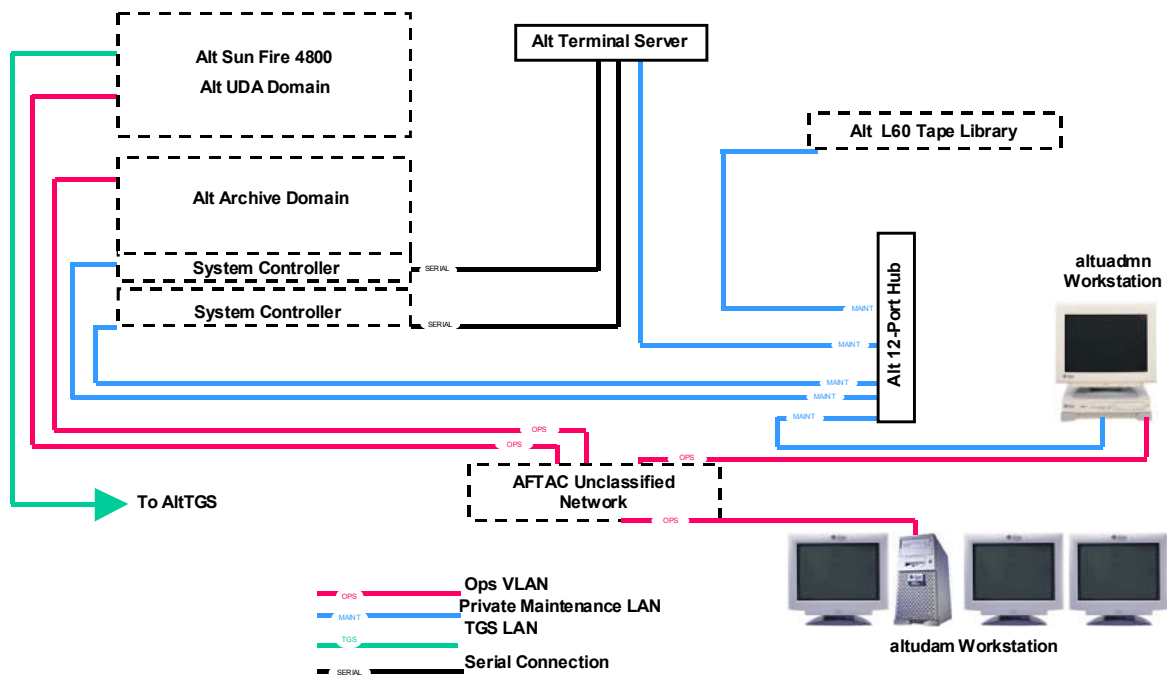


Figure 13. Unclassified Alternate Network Infrastructure Hardware Configuration Item

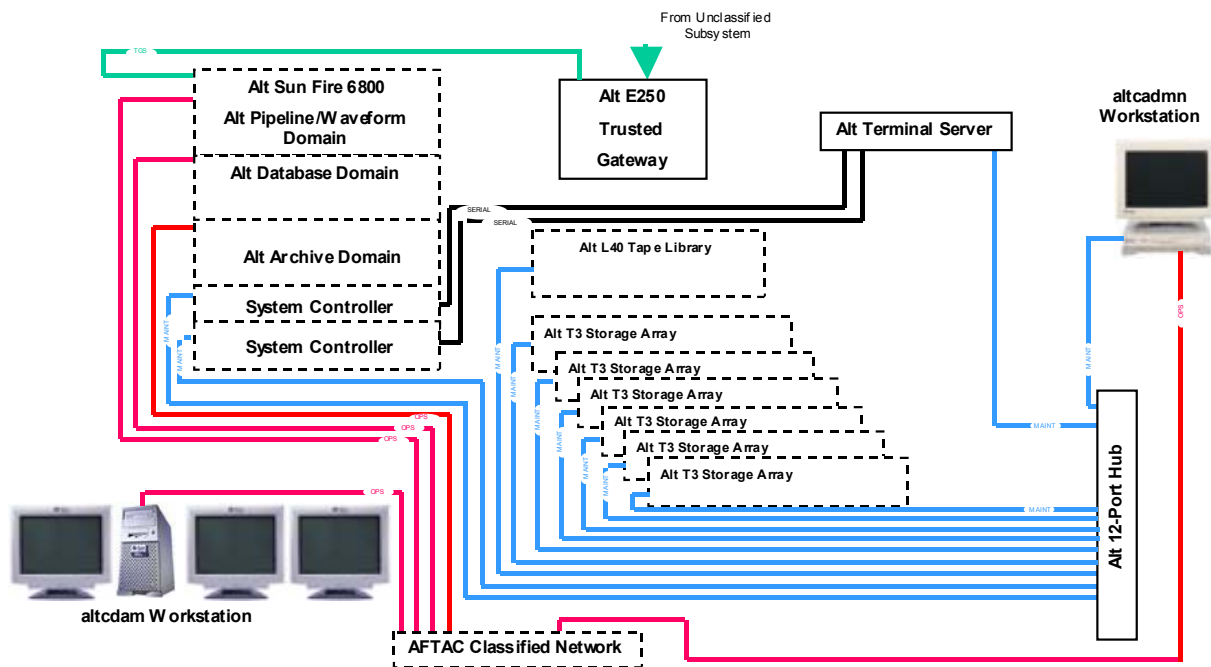


Figure 14. Classified Alternate Network Infrastructure Hardware Configuration Item

Table 30. Alternate Network Infrastructure Hardware Configuration Item Components

COMPONENT NAME	QUANTITY	LOGICAL NAME(S)
Alt Classified System/Network Administration Workstation	1	altcadmn
Alt Unclassified System/Network Administration Workstation	1	altuadm
Alt Classified Data Acquisition Manager Workstation	1	altcdam
Alt Unclassified Data Acquisition Manager Workstation	1	altudam
Alt TGS	2	alttgs
Alt Maintenance Hub	2	N/A
Alt Maintenance Terminal Server	2	N/A
Temperature Sensor	1	N/A
Alt Unclassified Printer	1	alt-ulp

4.1.2.2.8.1 Alternate United States National Data Center Classified and Unclassified Central Network Switches

Network connectivity between the Alt US NDC and external systems is provided by the AFTAC network, which is not considered part of the Alt US NDC or the US NDC. The Alt US NDC servers connect to the AFTAC network using Gigabit Ethernet Fiber. Alt US NDC workstations have 10/100Base-T interfaces and connect to the AFTAC network through 10Base-FL/100Base-TX transceivers.

Connectivity between the Alt US NDC and the US NDC is provided by a WAN that connects between the AFTAC network at PAFB, Florida and the AFTAC network at GAFB, Texas.

4.1.2.2.8.2 Classified and Unclassified Systems Alternate Network Administration Workstations

The Alt Network Administration Workstations provide the same function at the Alt US NDC as the Network Administration Workstations provide for the US NDC. These workstations are Sun Blade 100 workstations with 512 MB of memory.

4.1.2.2.8.3 Alternate Trusted Gateway System

The Alt TGS provides the same functionality at the Alt US NDC as the TGS provides to the US NDC.

4.1.2.2.8.4 Alternate Unclassified/Classified Data Acquisition Manager Workstations

The Alt udam and Alt cdam Workstations provide the same capability at the Alt US NDC as the udam and cdam provide for the US NDC, with the exception that the cdam Workstation is configured with an additional (fourth) monitor, to allow displaying SUN MANAGEMENT CENTER status, which is run on the Sun Fire servers that are part of the US NDC and the Alt US NDC. The SUN MANAGEMENT CENTER allows for centralized monitoring and control of the Sun Fire servers.

The Alt udam and Alt cdam Workstations are Sun Blade 2000 workstations configured with 1 GB of memory, a 900 MHz UltraSPARC III processor, four PGX32 video cards, and four 21-inch monitors.

4.1.2.2.8.5 Alternate United States National Data Center Temperature Sensor

The US NDC is located in the Headquarters Data Center (HDC) at PAFB, which has been equipped with a Sensaphone 1104 temperature sensor. The Sensaphone monitors temperature in the HDC and provides telephone notification if a temperature problem occurs in the HDC. Since the HDC houses computer systems other than the US NDC, the Sensaphone in the HDC is not considered part of the US NDC. In order to meet security requirements, the microphone in the HDC Sensaphone is disconnected.

To provide similar computer room temperature monitoring for the Alt US NDC, the Alt Network Infrastructure HWCI includes the same Sensaphone model 1104 temperature sensor. In order to meet security requirements, the microphone in the Alt US NDC Sensaphone is disabled.

4.1.2.2.8.6 Alternate United States National Data Center Unclassified Printer

A Lexmark Optra C720n color laser printer is included, to provide the capability to generate hardcopy output on the Alt US NDC network unclassified side.

4.1.2.2.9 Alternate Unclassified Data Acquisition Hardware Configuration Item

The US NDC server hardware overview shown in Figure 6 also applies to the Alt US NDC server hardware, since the US NDC servers and the Alt US NDC servers are identically configured.

The Alt Unclassified Data Acquisition HWCI performs the same function and is configured identically to the US NDC Unclassified Data Acquisition HWCI configuration. Table 31 lists the major Alt Unclassified Data Acquisition HWCI components along with each component's number of instances and logical name.

Table 31. Alternate Unclassified Data Acquisition Hardware Configuration Item Components

COMPONENT NAME	QUANTITY	LOGICAL NAME(S)
Diskloop Server/Sun Fire 4800 Data Acquisition Subsystem Domain	1	altda
A5200 Storage Array	2	N/A
D240 Media Tray	1	N/A

4.1.2.2.10 Alternate Unclassified Archive Hardware Configuration Item

The Alt Unclassified Archive HWCI performs the same function and is configured identically to the US NDC Unclassified Archive HWCI. Table 32 lists the major Alt Unclassified Archive HWCI components along with each component's number of instances and logical name.

**Table 32. Alternate Unclassified Archive Hardware
Configuration Item Components**

COMPONENT NAME	QUANTITY	LOGICAL NAME(S)
Unclassified Archive/Database Server/Sun Fire 4800 Archive Domain	1	altuarch
A5200 Storage Array	1	N/A
D240 Media Tray	1	N/A
L60 Tape Library	1	N/A

4.1.2.2.11 Alternate Classified Analysis Hardware Configuration Item

The Alt Classified Analysis HWCI performs the same function as the US NDC Classified Analysis HWCI, and is configured the same way as the US NDC Classified Analysis HWCI. Table 33 lists the major Alt Classified Analysis HWCI components of the along with each component's number of instances and logical name.

**Table 33. Alternate Classified Analysis Hardware
Configuration Item Components**

COMPONENT NAME	QUANTITY	LOGICAL NAME(S)
Waveform/Pipeline Server/Sun Fire 6800 Waveform/Pipeline Domain	1	altpipe
Pipeline Database Server/Sun Fire 6800 Pipeline Database Domain	1	altdbs
D240 Media Tray	2	N/A
T3 Storage Array	6	N/A
A5200 Storage Tray	2	N/A

4.1.2.2.12 Alternate Classified Archive Hardware Configuration Item

The Alt Classified Archive HWCI performs the same function as the US NDC Classified Archive HWCI and is configured the same way as the US NDC Classified Archive HWCI. Table 34 lists the major Alt Classified Analysis HWCI components along with each component's number of instances and logical name.

**Table 34. Alternate Classified Archive Hardware
Configuration Item Components**

COMPONENT NAME	QUANTITY	LOGICAL NAME(S)
Classified Archive/Database Server/Sun Fire 6800 Archive Domain	1	altcarch
A5200 Storage Array	1	N/A
D240 Media Tray	1	N/A
L40 Tape Library	1	N/A

4.1.2.2.13 Alternate Analyst/Evaluator Hardware Configuration Item

The Alt Analyst/Evaluator HWCI (see Figure 15) provides the same functionality as the US NDC Analyst/Evaluator HWCI, but the Alt Analyst/Evaluator HWCI is configured with fewer workstations. The Alternate System Operations Manager (Alt SOM) and Alt US NDC Analyst and Alt US NDC Evaluator Workstations provide the same functionality for the Alt US NDC as the SOM, Analyst, and Evaluator Workstations provide for the US NDC System.

While the US NDC Analyst/Evaluator HWCI Workstations are Sun Ultra 10 workstations, the Alt Analyst/Evaluator HWCI Workstations are Blade 2000 workstations. The Blade 2000 workstations are configured with 1 GB of memory, a 900 MHz UltraSPARC III processor, two PGX32 video cards, and two 21-inch monitors.

The Alt Analyst/Evaluator HWCI is also configured with a Lexmark Optra C720n color laser printer to provide the capability to generate hardcopy output.

Table 35 lists the major Alt Analyst/Evaluator HWCI components along with each component's number of instances and logical name.

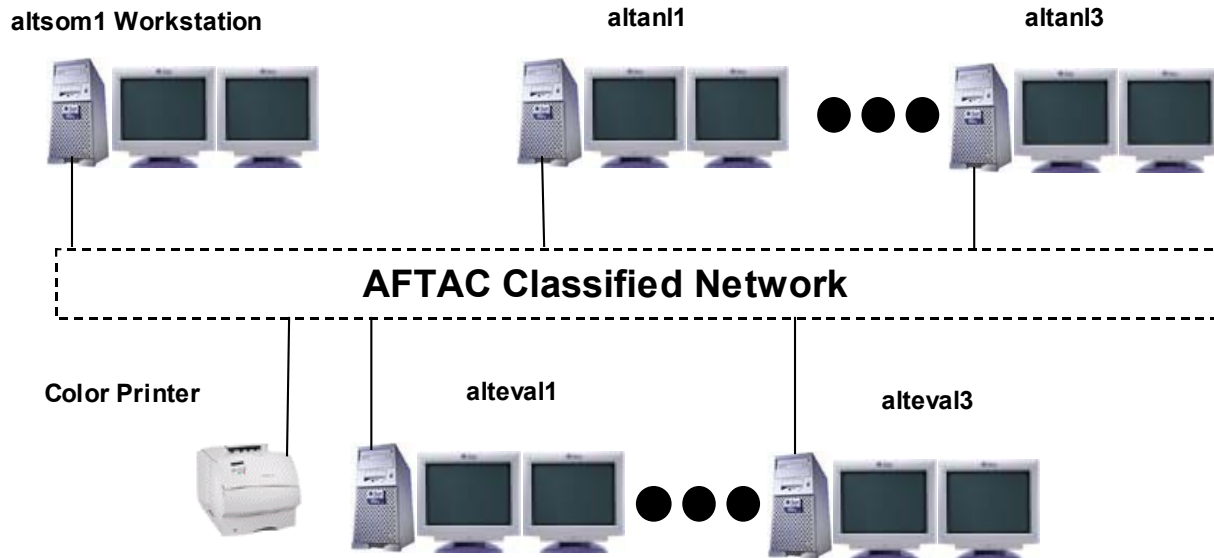


Figure 15. Alt Analyst/Evaluator Hardware Configuration Item

Table 35. Alternate Analyst/Evaluator Hardware Configuration Item Components

COMPONENT NAME	QUANTITY	LOGICAL NAME(S)
Analyst Workstation	3	altanl[1-3]
Evaluator Workstation	3	alteval[1-3]
SOM Workstation	1	altsom1
Color Printer	1	alteval-lp

4.1.2.3 Operations

There are several categories of personnel needed to operate the US NDC System and fulfill its mission requirements. The list of personnel include the SOM, DAM, system/network/database administrators, analysts, duty officer, and evaluators.

The operational tasks these personnel perform are briefly described in the following sections. The duties are described in the TI Manuals *United States National Data Center (US NDC) Phase 1 Upgrade Technical Manual, Installation, Operation, Principles of Operation, Maintenance, Illustrated Parts Breakdown, and System Diagrams*, TI 2-NDC-2, *United States National Data Center (US NDC) Phase 1 Upgrade Technical Manual, Operation, Principles of Operation and Fault Verification*, TI 2-NDC-1, and the US NDC Training System TI.

4.2 Concept of Execution

The first part of this section provides a system execution overview based on the functional subsystems and describes how the subsystems interact during operation to fulfill the system's mission. The subsequent sections describe the internal operation of each subsystem.

In the following sections, the sequences of events that take place during system operation are described using event trace diagrams and event trace description tables. Events occur between system components during processing, triggered by certain actions. The event trace diagrams display system components from left to right using vertical lines, with the flow of time displayed from top to bottom. Events are represented by solid arrows and are numbered and time-ordered according to processing flow. The event trace description tables provide context for the event flow diagrams. The event number and the CSCI and processing thread included in the event are listed. The action that triggered the event, an event description, and frequency of processing that occurs during the event are also listed.

Note: Events can occur concurrently even though the event trace diagram is sequential by nature.

4.2.1 System Execution

The main execution of the system is data-driven. The subsystems operate autonomously but are related to one another by the movement of data through the system. Figure 16 provides a system top-level functional flow diagram based on the major subsystems listed in Table 1.

4.2.1.1 Operation

On the Unclassified System, the Unclassified Data Acquisition Subsystem acquires data from unclassified senders and forwards data to unclassified receivers. The Unclassified Data Acquisition Subsystem forwards data to the Classified Data Acquisition Subsystem through the secure TGS link. The DAM monitors and controls the Unclassified Data Acquisition Subsystem processing. The Unclassified Archive Subsystem archives all data acquired by the Unclassified Data Acquisition Subsystem. Researchers have access to the data stored in the Unclassified Archive Subsystem. On the Classified System, the Classified Data Acquisition Subsystem acquires data from classified senders. The Classified Data Acquisition Subsystem receives data from the Unclassified Data Acquisition Subsystem via the TGS link. The DAM monitors and controls the Classified Data Acquisition Subsystem processing. The Classified Analysis Subsystem automatically processes data received by the Classified Data Acquisition Subsystem and provides performance-monitoring results. The analysts and evaluators interactively analyze the automatic processing results in the Classified Analysis Subsystem. The SOM monitors and controls the Classified Analysis Subsystem processing. The Classified Archive Subsystem archives all data acquired by the Classified Data Acquisition Subsystem and all data created by the Classified Analysis Subsystem. Researchers have access to the data stored in the Classified Archive Subsystem and the Classified Analysis Subsystem.

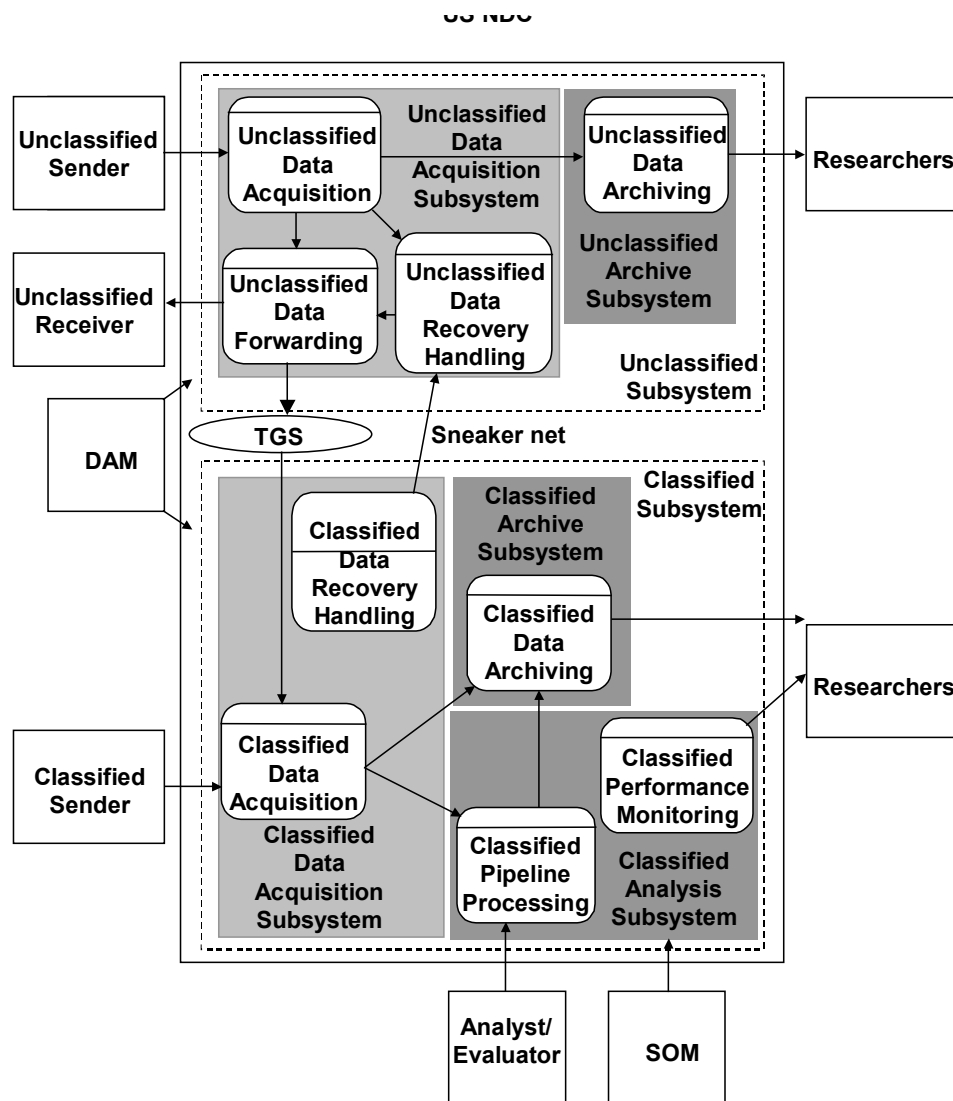


Figure 16. United States National Data Center Top-level Functional Flow

4.2.1.2 Data Flow and Control

Waveform data is acquired by the Unclassified Data Acquisition Subsystem and Classified Data Acquisition Subsystem from external unclassified and classified sources, respectively. The Unclassified Data Acquisition Subsystem receives data in different formats from different sources. These formats are CD-1.0, CD-1.1, DTC, and CSS 3.0. All data that is not CD-1.1 is converted by the Unclassified Data Acquisition Subsystem to CD-1.1. All CD-1.1 frames received or converted by the Unclassified Data Acquisition Subsystem are written to a CD-1.1 framestore in CD-1.1 format. The frames in the framestore are parsed and written to diskloops on the Unclassified Data Acquisition Subsystem. The Unclassified Data Acquisition Subsystem forwards all CD-1.1 data to the Classified Data Acquisition Subsystem through a TGS. It also forwards some CD-1.0 and CD-1.1 data to external receivers via a forwarding subsystem. The

Unclassified Archive Subsystem provides a long-term archive of data it obtains from the diskloops.

The Classified Data Acquisition Subsystem receives CD-1.1 data from the Unclassified Data Acquisition Subsystem and CD-1.0 classified hydroacoustic data from external sources. All CD-1.0 data received at the Classified Data Acquisition Subsystem is converted to CD-1.1 using the same methods used on the Unclassified Data Acquisition Subsystem. All CD-1.1 frames received or converted by the Classified Data Acquisition Subsystem are written to a CD-1.1 framestore in CD-1.1 format. Frames in the framestore are parsed and written to diskloops on the Classified Data Acquisition Subsystem. The Classified Archive Subsystem provides a permanent archive of data it obtains from the diskloops.

Summaries of acquired data, station status, and the health of data services are presented to the DAM. The DAM provides manual control of these subsystem processes. Once waveform data is acquired by the Classified System, the Classified Analysis Subsystem automatically retrieves the data from the diskloop storage, processes the data, and stores the processing results. Operations staff interactively analyze and evaluate the waveform data and the intermediate processing results. Run-time status of processes and workflows are provided to the SOM. Performance Monitoring data is extracted from the subsystems and are summarized for use by the SOM and external users.

4.2.1.3 Sequencing and Timing

The Unclassified Data Acquisition Subsystem and Classified Data Acquisition Subsystem are designed to meet the implied requirement of making the data available for processing within minutes after data receipt. Database usage is configured to provide timely updates of new data while minimizing database loading. The system response may be tuned by changing the number of database connects or the update frequency, but the trade-off for faster response time is greater database loading, which has the potential to impact other system parts.

The Classified Analysis Subsystem automated station processing is initiated when a sufficient fraction of data in a 15-minute interval is available for processing at a station. Network processing is initiated upon the completion of station processing for a sufficient number of stations in a 30-minute interval or by the elapsing of the interval. Interactive processing is performed as directed by the SOM when sufficient network processing intervals have been completed. The post-analysis automated processing occurs only after the completion of interactive analysis, but there is no inherent timing involved.

4.2.2 Unclassified Data Acquisition Subsystem Execution

4.2.2.1 Unclassified Data Acquisition

For data arriving in CD-1.0 (also called Alpha) protocol, control begins with an external connection request coming from a data sender. The sockd program initially fields the request, then invokes a *ConnMan* program. *ConnMan* reads the database to learn about the active *DLMan* processes. *ConnMan* chooses a *DLMan*, establishes a connection to that *DLMan*,

negotiates for station acceptance, then returns the *DLMan* address to the data sender. At this point, *ConnMan* has completed its task and exits. *DLMan* waits for connections from the data sender. As data arrives, *DLMan* converts the data to CD-1.1 and writes the data to the Unclassified Data Acquisition Subsystem framestore. *DLMan* retains control until the connection with the data sender is broken. The data acquisition components are illustrated in Figure 17.

For data arriving in the CD-1.1 protocol the sender requests a connection by sending a Connection Request Frame to the Unclassified Data Acquisition Subsystem. The Unclassified Data Acquisition Subsystem's UNIX daemon *inetd* starts a *ConnMgr* process. *ConnMgr* then receives the Connection Request Frame. *ConnMgr* reads the database to determine the address of a *ConnMgr-server* and sends a port request to the server. This causes *inetd* to start a *ConnMgr-server* process, which then receives the port request. The *ConnMgr-server* reads a parameter file to determine a port number for the sender connection. *ConnMgr-server* returns the port number in a Port Response Message to *ConnMgr*. *ConnMgr* returns a Connection Response Frame to the sender with the server address and port. The sender sends an Option Request Frame to the *ConnMgr-server*. The server returns an Option Assignment Frame to the sender. *ConnMgr-server* starts the *FrameEx* process. Communication begins between the sender and *FrameEx*. *ConnMgr* and *ConnMgr-server* terminate because their task is complete.

For data arriving in DTC protocol from USAEDS stations, the process *StationToFS* requests a connection to the USAEDS stations. Once the connection is established, the station sends realtime data to *StationToFS* for processing.

For data arriving in CSS 3.0 format from AFTAC Southern Network (ASN) stations, the process *putfiled* starts and waits for connection from the process *putfile* on the CSS 3.0 station. Once the connection is established, *putfile* sends data to *putfiled*. The *putfiled* process writes the information to CSS 3.0 formatted files. The process *feed_file2alpha* reads the files and creates a trigger file containing the CSS 3.0 data to be read by the process *StationToFS*.

Interactive requests for late USAEDS station data can be submitted on the udam. The process *LateData* obtains the necessary File Transfer Protocol (FTP) files to fulfill the request through the ADSN System and writes the files to the Unclassified Data Acquisition Subsystem. *LateData* then reads the files and produces a trigger file to read by the process *StationToFS*.

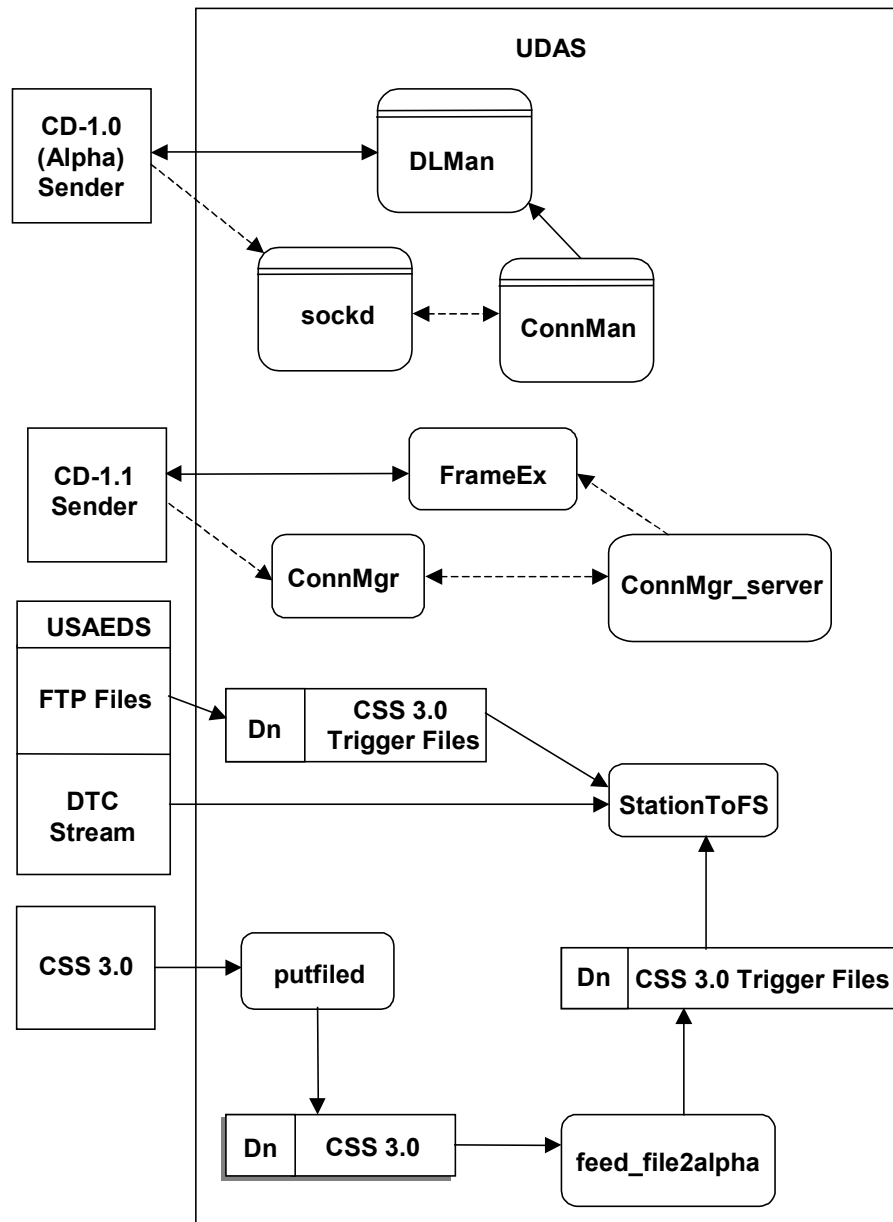


Figure 17. Unclassified Data Acquisition Subsystem Front End

The following failure conditions are handled by the Unclassified Data Acquisition Subsystem:

- Failed connection request from data sender
- Time-out with data sender
- Failed connection with the database

- Failed *ConnMan*
- Failed *DLMAN*
- Failed connection with external

The failed connection request from a data sender results from an attempt to connect that does not pass station verification. The provided station name and the request's actual Internet Protocol (IP) address are checked against the valid list of stations and IP addresses. On a failure, the *ConnMan* drops the request with no notice given to the requestor. The recourse for a valid station is to attempt the connection a second time.

On a time out with a data sender, *DLMAN* drops the connection. Either the data sender or the communications link has failed, UNIX doesn't provide the information to distinguish between the two. In either case, the recourse is for the station to reconnect to the US NDC.

For the failed database connection, *DLMAN* caches the updates it would have submitted to the database. *DLMAN* continues to accept data and cache updates until either the database returns to service or *DLMAN* attempts to read dynamic information from the database. In the first case, *DLMAN* submits the cached updates and continues processing as if the database never had the problem. In the second case, *DLMAN* stops functioning until the database has been repaired. To extend the interval of processing without the database, *DLMAN* also retains the database static information it obtained for the various stations to avoid any unnecessary additional reads.

The *ConnMan* program failure is masked by the sockd utility. The sockd utility starts configured programs such as *ConnMan* automatically when requested via incoming socket connection attempts.

An operator must correct the *DLMAN* program failure. However, multiple *DLMAN* programs may run concurrently, and the remaining *DLMAN* programs can carry the load for a failed *DLMAN* instance. The stations that were connected to the failed *DLMAN* time-out then attempt to re-establish a connection. *ConnMan* assigns these stations to the surviving *DLMAN* instances.

4.2.2.2 Unclassified Data Acquisition Subsystem Data Flow

Processes reside on the Unclassified Data Acquisition Subsystem to handle the data received from different sources in the various formats. The *FrameEx* process receives data in CD-1.1. The *DLMAN* process receives data in CD-1.0 format and converts the data to CD-1.1 format. The *StationToFS* process receives data in DTC format and CSS 3.0 format (*LateData* is in CSS 3.0 format) and converts the data to CD-1.1 format. Each process writes the data it receives to the Unclassified Data Acquisition Subsystem framestore in CD-1.1 format.

Once the data is in the Unclassified Data Acquisition Subsystem framestore, various processes access it for special purposes. The process *FStoFile* reads frames from the framestore and forwards them to the Classified Data Acquisition Subsystem through the TGS. The process *DLParse* reads frames from the framestore and writes the data to the diskloop. The Flat File Archiving Subsystem archives the diskloop data to the Unclassified Archive. The Forwarding

Subsystem reads frames from the framestore and forwards the data to external CD-1.0 and CD-1.1 receivers. Figure 18 illustrates Unclassified Data Acquisition Subsystem data flow.

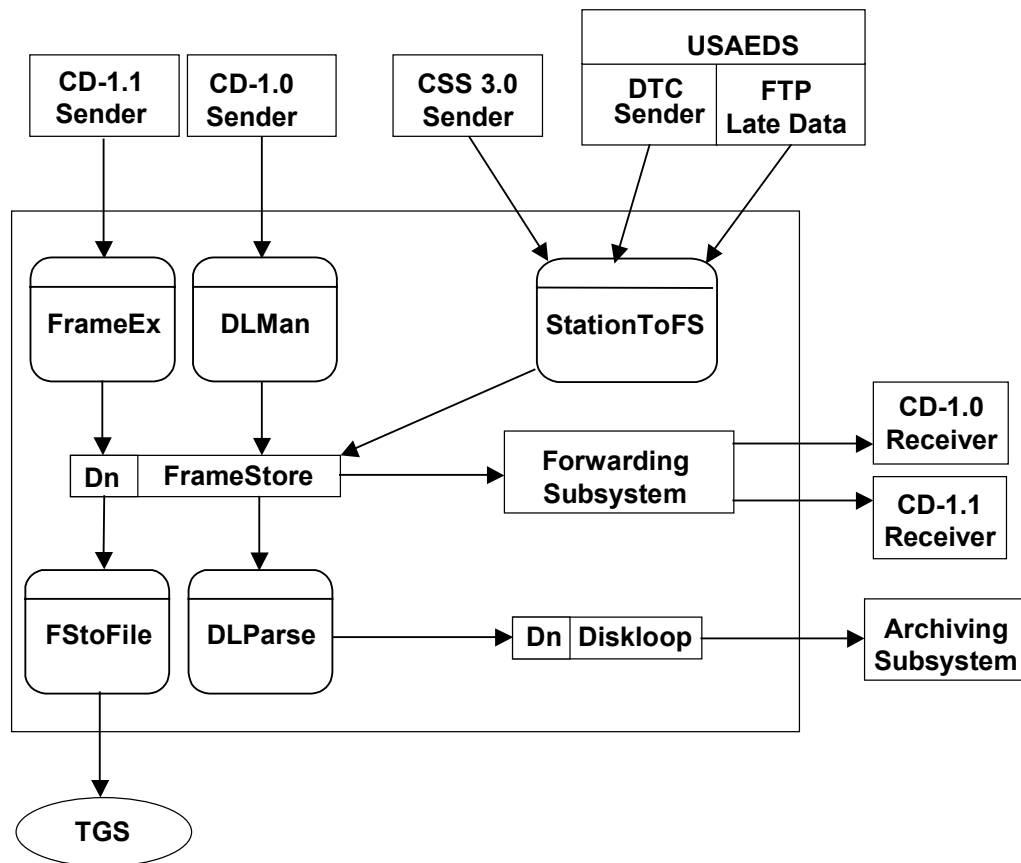


Figure 18. Unclassified Data Acquisition Subsystem Data Flow

Figure 19 shows a trace of the events that take place during Unclassified Data Acquisition. Table 36 provides an event description summary.

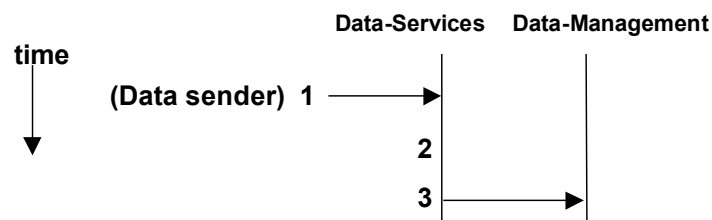


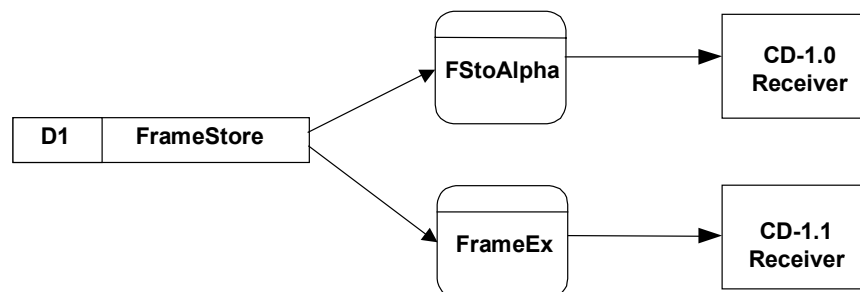
Figure 19. Unclassified Data Acquisition Event Trace

Table 36. Unclassified Data Acquisition Event Trace Description

EVENT NO.	CSCI	THREAD	EVENT TRIGGER	EVENT DESCRIPTION	PROCESSING FREQUENCY
1	Data-Services	Unclassified data acquisition	Data sent by unclassified sender.	Data received into Unclassified Data Acquisition Subsystem.	Continuous
2	Data-Services	Unclassified data forwarding	New frames in framestore.	Data sent to unclassified receiver and to Classified Data Acquisition Subsystem.	Continuous
3	Data-Management	Unclassified data acquisition	New frames in framestore.	Data stored in diskloop and wfdisc table updated.	Periodic

4.2.2.3 The Forwarding Subsystem

The Forwarding Subsystem (see Figure 20), composed of two processes, is part of the Unclassified Data Acquisition Subsystem. The process *fs2alpha* reads data from the Unclassified Data Acquisition Subsystem framestore and converts the data to CD-1.0 format. The converted data is then forwarded to a CD-1.0 external receiver. The process *FrameEx* reads data from the Unclassified Data Acquisition Subsystem framestore and forwards the data to a CD-1.1-based data center.

**Figure 20. Unclassified Data Acquisition Subsystem Forwarding Subsystem**

4.2.2.4 Low-to-High Transfer Subsystem

The Low-to-High Transfer Subsystem's primary purpose is to replicate the contents of the unclassified framestore on the Unclassified System to the classified framestore on the Classified System. A secondary purpose is to transfer periodic ASCII files from the Unclassified System to the Classified System (see Figure 21).

The TGS is the heart of the Low-to-High Transfer Subsystem. The TGS allows files to be copied to a specified directory known as the dirty directory on the Unclassified System and then makes these same files available in another directory known as the clean directory on the Classified System.

FStoFile reads from the unclassified framestore and writes data frames into individual files in the dirty directory. The corresponding program *FiletoFS* reads files from the clean directory and saves the data frames in the classified framestore.

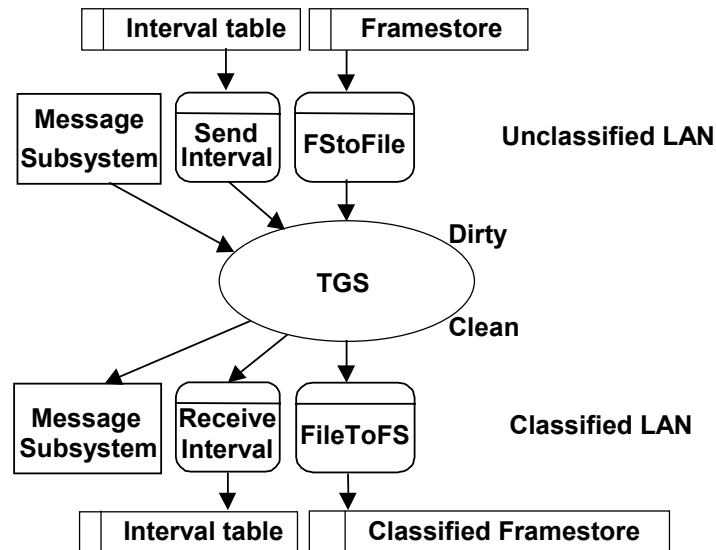


Figure 21. Low-to-High Transfer Subsystem Data Flow

4.2.2.5 Data Recovery Subsystem

The Data Recovery Subsystem provides a means to retransmit CD-1.1 data frames from the Unclassified Data Acquisition Subsystem framestore to the Classified Data Acquisition Subsystem framestore through the TGS to recover from severe system component failures. Figure 22 shows the Data Recovery System components' data flows.

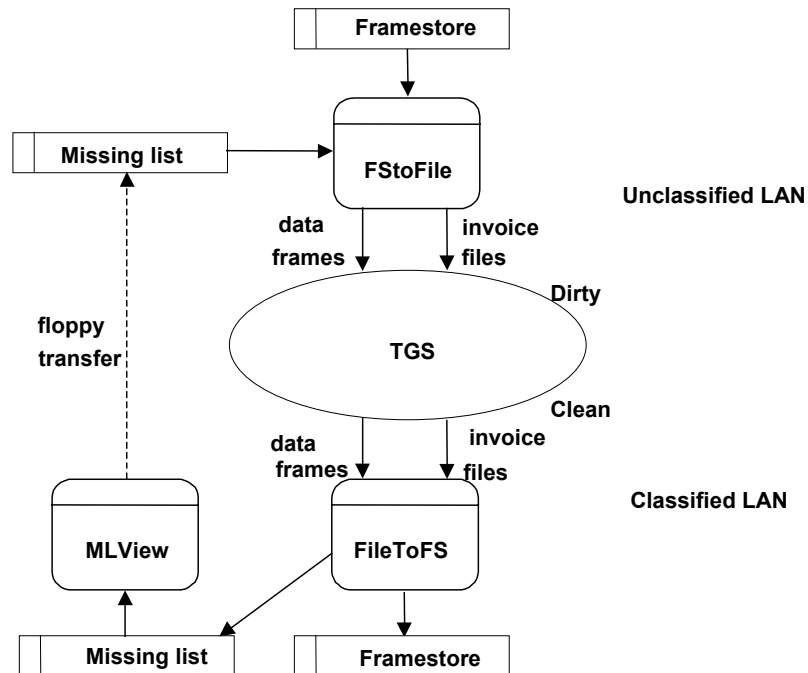


Figure 22. Data Recovery Subsystem Data Flow

In normal operations, the Low-to-High Transfer Subsystem transfers CD-1.1 frames from the Unclassified Data Acquisition Subsystem framestore through the TGS to the Classified Data Acquisition Subsystem framestore. The process *FStoFile* creates invoice files identifying the frames it transferred during its previous processing cycle, and the invoice files are also transferred across the TGS. The process *FiletoFS* attempts to find in the Classified Data Acquisition Subsystem framestore each frame identified in the invoice file. If it fails to locate frames in the framestore it adds the frame identification to the missing list bulletin. The *MLView* process polls the missing list, discovers any new entries, and updates its display indicating the missing frames. By observing *MLView*, the operator can determine at a glance that frames are missing. The operator commands *MLView* to send the missing list to a removable media device (floppy disk). The operator then transfers the removable media to the low-side media reader and copies the missing list bulletin to an established location. *FStoFile* reads the updated missing list and transfers the identified CD-1.1 frames from the Unclassified Data Acquisition Subsystem framestore via the Low-to-High Transfer Subsystem to the Classified Data Acquisition Subsystem framestore. *FiletoFS* periodically compares frames identified in the missing list against the Classified Data Acquisition Subsystem framestore and removes frames that are fulfilled from the missing list. Figure 23 shows a data recovery event trace. Table 37 provides an event description summary.

**Figure 23. Data Recovery Event Trace****Table 37. Data Recovery Event Trace Description**

EVENT NO.	CSCI	THREAD	EVENT TRIGGER	EVENT DESCRIPTION	PROCESSING FREQUENCY
1	Data-Services	Data transfer completeness check	Invoice file arrives on classified side.	FiletoFS verifies if all frame are in the framestore.	Continuous
2	Data-Services	Data transfer completeness check	Frame discovered missing in framestore.	FiletoFS adds frame ID to the missing list bulletin.	Once per missing frame
3	Data-Services	Missing frame alert	MLView polls the missing list.	MLView displays missing frame.	Once per missing frame
4	Data-Services	Operator action	Operators alerted to missing frame.	Operator transfers missing list to unclassified side.	Operator discretion
5	Data-Services	Data transfer	Updated missing list available.	FStoFile retransmits frames identified in missing list	Once per missing frame
6	Data-Services	Data transfer	Next processing cycle.	FStoFile transmits invoice file for frames previously transmitted.	Continuous
7	Data-Services	Data transfer completeness check	Frame now in framestore.	FiletoFS updates missing list.	Upon every transfer

4.2.2.6 Unclassified Monitoring and Control

The Unclassified Monitoring and Control component provides monitoring tools to see status within the Unclassified Data Acquisition Subsystem and allows the DAM to take action to

change subsystem operations. Figure 24 illustrates the Unclassified Monitoring and Control component's programs and data flows.

The control flow is explicitly driven by the operator, whereby programs are started or stopped through the Launch GUI. The WorkFlow GUI and the station utility read data from the interval and timestamp tables, respectively for status indication. WorkFlow automatically updates its display every 60 seconds and handles a database outage by sleeping and attempting to reconnect at a later time.

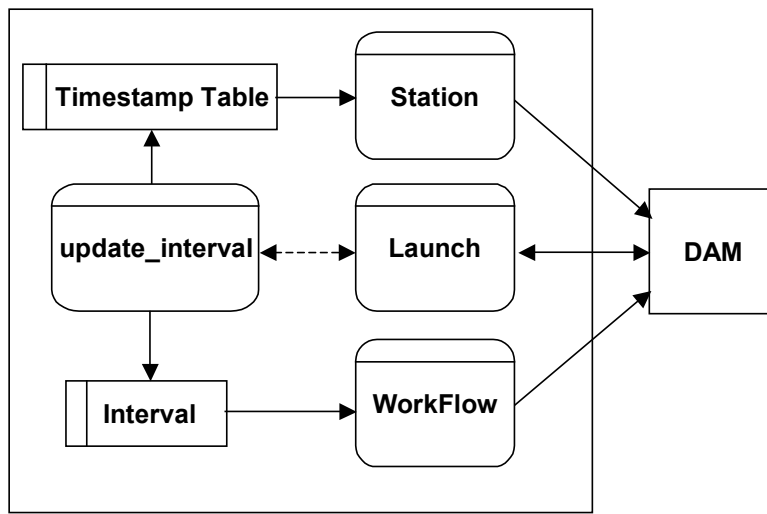


Figure 24. Unclassified Monitoring and Control Data Flow

4.2.3 Unclassified Archive Subsystem Execution

The Unclassified Archive Subsystem is archiving functionality responsible for the long-term storage of data acquired by the Unclassified Data Acquisition Subsystem. Figure 25 shows the archiving processes' data flow.

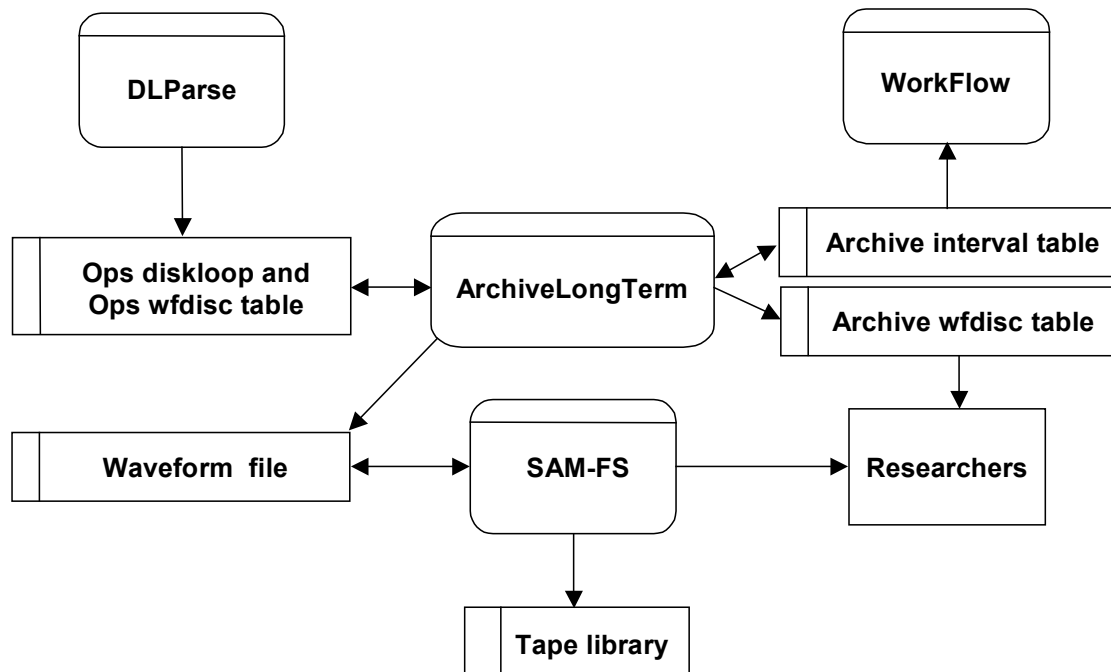


Figure 25. Unclassified Data Archiving Data Flow

As data arrives at the framestore, the process *DLParse* reads it from the framestore, parses it, and stores it in Unclassified Data Acquisition Subsystem diskloop, and the alphanumeric descriptive records are maintained in the operations database.

The process *ArchiveLongTerm* wakes up periodically, reads full two-hour intervals from the diskloop, and copies the data into files located on long-term storage. If a diskloop is not full, *ArchiveLongTerm* copies the available waveforms to long-term storage after ten days. The alphanumeric descriptive records are maintained in the archive database. *ArchiveLongTerm* also removes waveforms and archive database descriptive records older than 180 days. Since long-term storage is physically a tape robot, SAM-FS is used to manage the data on the tape giving a logical appearance of on-line storage. The logical long-term storage directory structure format is /YYYY/DDD/HH_HH (e.g., /2001/034/00_02). The waveform file name format is SITE-NAME.HH_HH.YYYYDDD.w (e.g., TXAR.00_02.2001034.w).

If *ArchiveLongTerm* detects a failure condition, it aborts for that data interval and continues with the remainder of the data. During the next iteration the data interval is examined again. Figure 26 shows a trace of the events that take place during unclassified data archiving. Table 38 provides an unclassified data archiving event trace summary description.

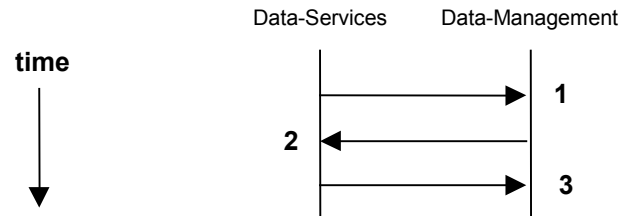


Figure 26. Unclassified Data Archiving Event Trace

Table 38. Unclassified Data Archiving Event Trace Description

EVENT NO.	CSCI	THREAD	EVENT TRIGGER	EVENT DESCRIPTION	PROCESSING FREQUENCY
1	Data-Management	Data archive	<i>ArchiveLongTerm</i> does 2-hour periodic processing.	<i>ArchiveLongTerm</i> retrieves waveforms from diskloops and writes to long-term storage.	Periodic, every 2 hours
2	Data-Services	Data parsing	Waveform data present in diskloop for 13 days.	DLParse removes ops wfdisc records and recycles diskloop files.	Periodic
3	Data-Management	Data archive	Waveform data present in long-term storage for 180 days.	<i>ArchiveLongTerm</i> removes archive wfdisc records and recycles DLT tape.	Periodic

4.2.4 Classified Data Acquisition Subsystem Execution

4.2.4.1 Classified Data Acquisition and Data Flow

The Classified Data Acquisition Subsystem receives data from classified stations and from the Unclassified System via the TGS (see Figure 27). The *DLMan* process receives data in CD-1.0 protocol from classified stations and converts the data to CD-1.1 format. The process *FiletoFS* receives data from the TGS in CD-1.1 format. Each process writes the data to the Classified Data Acquisition Subsystem framestore. The process *DLParse* reads frames from the framestore and writes data to the diskloop. Data in the diskloops are read by the Classified Analysis Subsystem for processing and by the Archive Subsystem for archiving.

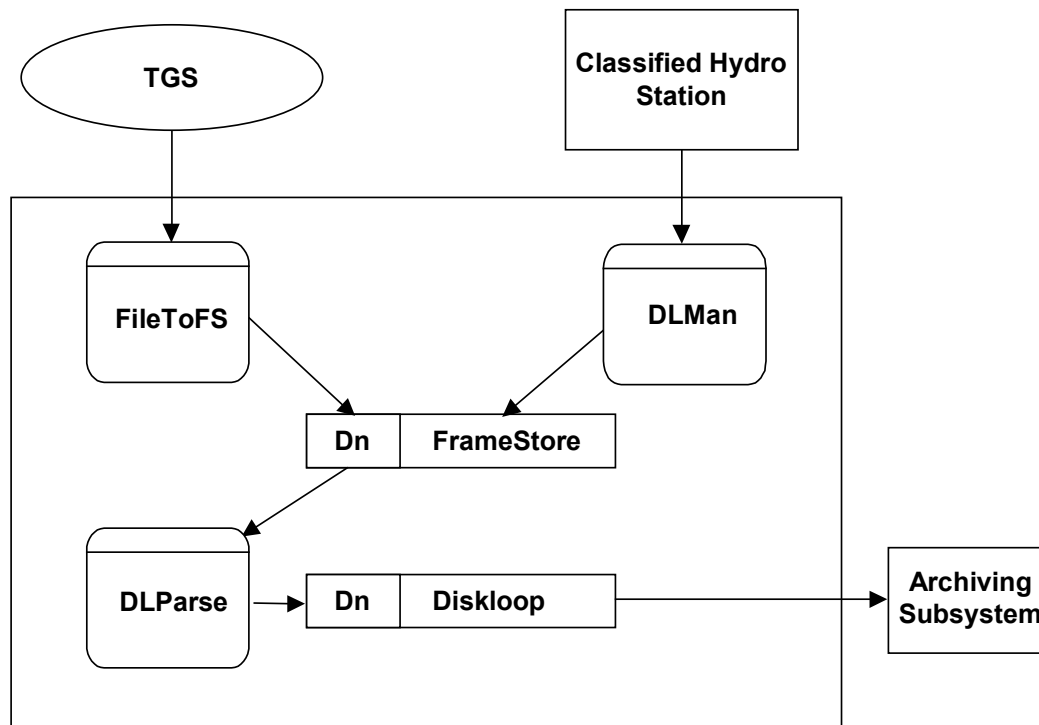


Figure 27. Classified Data Acquisition Data Flow

4.2.5 Classified Archive Subsystem Execution

The Classified Archive Subsystem is responsible for archiving data to long-term and permanent storage and for restoring archived data, as shown in Figure 28.

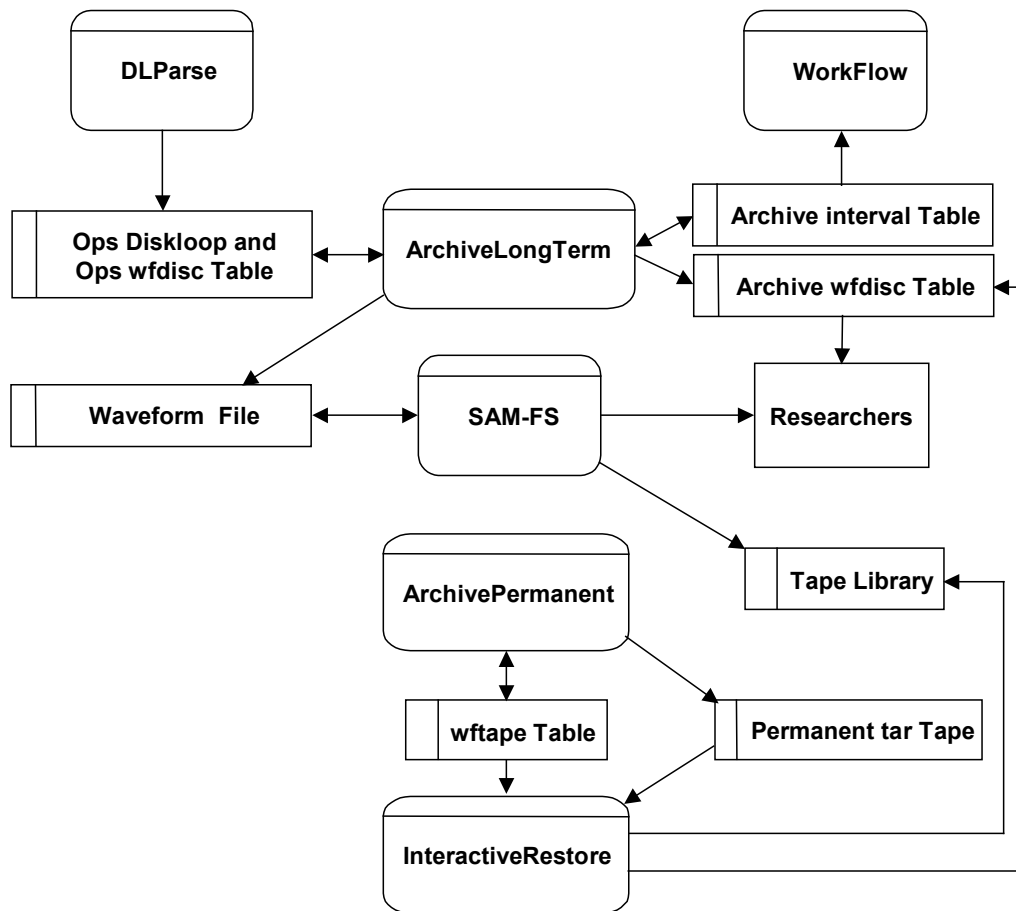


Figure 28. Classified Data Archiving Data Flow

The process *ArchiveLongTerm* wakes up periodically reads full two-hour intervals from the Classified Data Acquisition Subsystem diskloops, and copies the waveforms into files located on long-term storage. If an interval is not full, *ArchiveLongTerm* copies the available waveforms to long-term storage after ten days. The alphanumeric descriptive records are maintained in the archive database. *ArchiveLongTerm* also removes waveforms older than sixty days. Since long-term storage is physically a tape robot, SAM-FS is used to manage the data on the tape giving a logical appearance of on-line storage. The logical long-term storage directory structure format is /YYYY/DDD/HH_HH (e.g., /2001/034/00_02). The waveform file name format is SITE-NAME.HH_HH.YYYYDDD.w (e.g., TXAR.00_02.2001034.w).

The process *ArchivePermanent* runs every 24 hours and places all intervals older than 45 days old on permanent storage by utilizing a system call to the UNIX tape archive (tar) command. The **wftape** table is used to identify each file written to permanent storage.

An operator using the *InteractiveRestore* process can restore data in permanent storage to long-term storage. *InteractiveRestore* uses the **wftape** table to determine the files to restore. It also uses the **wfdisc** table records.

If one of the programs detects a failure condition, it aborts for that data interval and continues with the remaining data. During the next iteration, the data interval is examined again.

Figure 29 shows a trace of the events that take place during classified data archiving. Table 39 provides a classified data archiving event trace description summary.

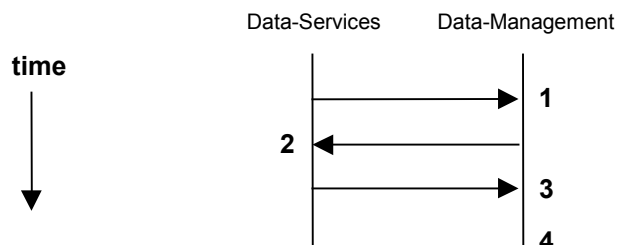


Figure 29. Classified Data Archiving Event Trace

Table 39. Classified Data Archiving Event Trace Description

EVENT NO.	CSCI	THREAD	EVENT TRIGGER	EVENT DESCRIPTION	PROCESSING FREQUENCY
1	Data-Management	Data archive	<i>ArchiveLongTerm</i> does 2-hour periodic processing.	<i>ArchiveLongTerm</i> retrieves data older than 10 days from diskloops and writes to long-term storage.	Periodic, every 2 hours
2	Data-Services	Data parsing	Waveform data present in diskloop for 45 days.	<i>DLParse</i> removes ops wfdisc records and recycles diskloop files.	Periodic
3	Data-Management	Data archive	Waveform data present in diskloop for 45 days.	<i>ArchivePermanent</i> creates a waveform tar file on permanent storage and corresponding wftape records.	Periodic, every 24 hours
4	Data-Management	Data archive	Waveform data present in long-term storage for 60 days.	<i>ArchiveLongTerm</i> removes long-term wfdisc records and recycles DLT tape.	Periodic

4.2.6 Classified Analysis Subsystem Execution

4.2.6.1 Classified Pipeline Processing

This section describes the general execution for the numerous interactive analysis stages and automated processes used by the Classified Analysis Subsystem. The individual paragraphs provide a brief description of each stage's or process's basic purpose, the corresponding input and output data, and a process flow diagram. The input and output section lists the information and data for each analysis or processing stage and the output it is expected to produce.

The data received at the Classified Analysis Subsystem are processed differently according to the data type and the processing goal. Processing is accomplished with four pipelines as listed in Table 40. The set of processes involved and the database accounts used characterize each pipeline. The main purpose of each pipeline is summarized here:

- The Global pipeline builds a global bulletin with short period (SP) and long period (LP) seismic data and performs classification for events of interest using seismic data and hydroacoustic arrivals associated with offshore events. Within a specified broad geographic area, the bulletin built by the Global pipeline also includes seismic arrivals and events based on data recorded at stations located at regional distances
- The Spotlight pipeline builds a regional bulletin for specified areas and estimates regional magnitude
- The Look-Forward pipeline provides rapid notification of events in configurable, pre-defined target areas and validates and refines target events on an accelerated schedule, making the data available for rapid analysis
- The Hydroacoustic pipeline detects and identifies hydroacoustic phases with high signal-to-noise ratio (SNR)

Each pipeline performs a specific set of processes directed to the pipeline goal. Processing scheduling is initiated on the availability of data under an intelligent algorithm. The algorithm strives for completeness but waits only a limited time for missing data. Data that arrive too late for a processing stage are subject to preliminary processing and inserted into a later processing stage as feasible. Of the four pipelines, the Global pipeline is the most complex and extensive processing model.

Table 40. United States National Data Center Pipelines

PIPELINE	GOAL	TIMELINESS	COVERAGE
Global	Global teleseismic, regional in specific broad area	6 to 8 hours	Worldwide, small events in selected broad regional area
Spotlight	Local, Regional	1 hour	Selected local areas, small events
Hydroacoustic	Oceanic	4 to 6 hours	Large marine events
Look-Forward	Special Interest	15 minutes	Targeted areas

4.2.6.1.1 Pipeline Control Using Distributed Application Control System Support

A pipeline is a sequence of data processes applied to a data stream, which begins as raw unprocessed waveform data. A sequence of processing requires a control mechanism to schedule the component processes and to monitor them for successful completion and take corrective action in the case of a failure. In addition, a process may not be running when initially requested and the controlling mechanism may need to start it, or a process may have failed and the controlling mechanism may need to restart it. The controlling mechanism is configured to implement each pipeline stage with its own internal controls, depending on the nature of data processing performed in each stage. Tuxedo provides this control infrastructure. It provides for the exchange and queuing of processing request messages, which cause data processing to be performed and initiates the processes that perform the processing tasks. The Tuxedo installation on the Classified Analysis HWCI data processing server is standalone and services only the automated processing running on the server.

Each automated pipeline stage contains at least two processes in a sequence. A controlling process called *sequencer* is responsible for queuing a steady stream of messages, each representing individual time interval segments of raw or partially processed waveform data that the processes are to complete. The tuxpad and WorkFlow GUIs allow control and status monitoring information regarding the processes and the time intervals being processed in the pipeline, respectively. The tuxpad GUI provides the SOM with control of all Tuxedo services which, in turn, automatically starts pipeline processes, as needed. The WorkFlow GUI provides the SOM the capability to manually reschedule processing of a particular data interval as needed for processing pipelines management.

Figure 30 shows each process, which together make up the DACS for automatic processing.

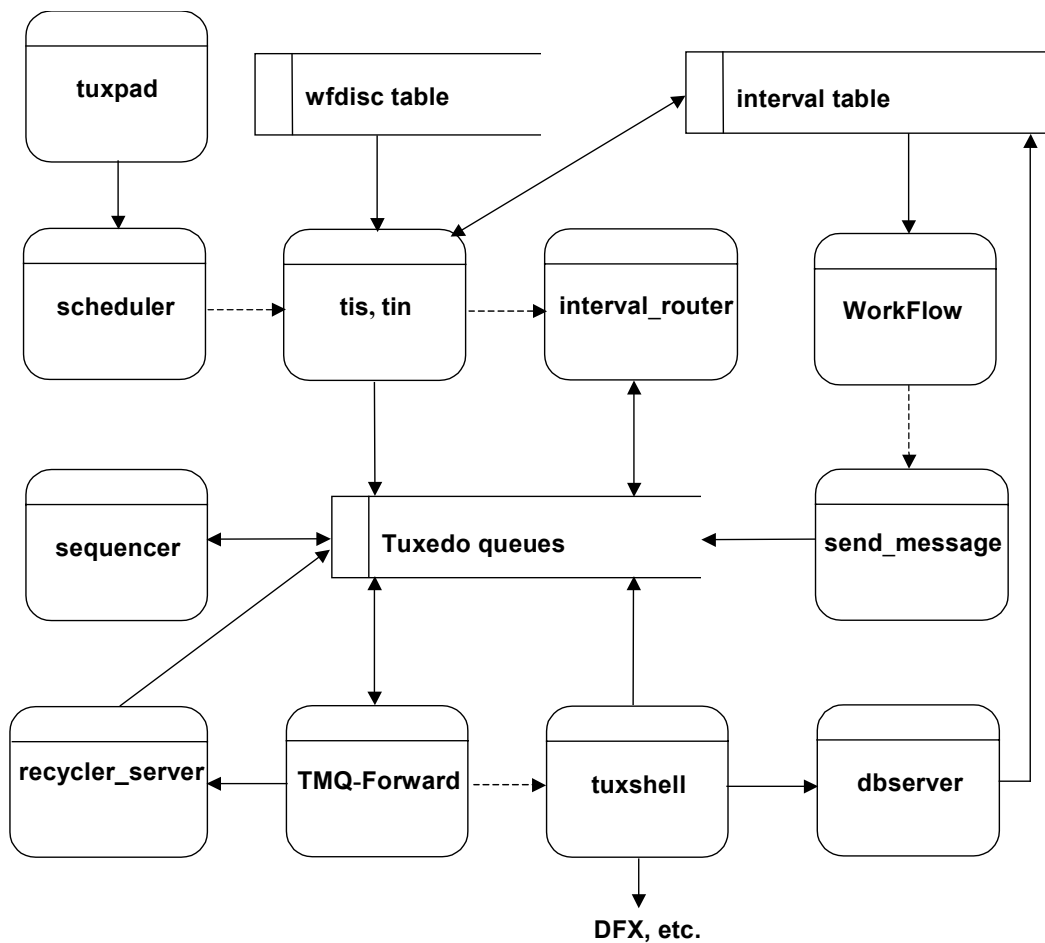


Figure 30. Tuxedo-based Distributed Application Support in Automatic Processing

Tuxedo provides the infrastructure to allow the exchange of data messages between two interactive processes, which run on an Analyst/Evaluator Workstation. The *dman* process is responsible for starting an interactive process if a message is sent and the receiving process is not already running. Figure 31 shows the control relationship between *dman* and interactive processes. The tuxpad GUI is not applicable to interactive processing. The Tuxedo installation on a workstation is stand-alone and services only the individual logged in on the workstation.

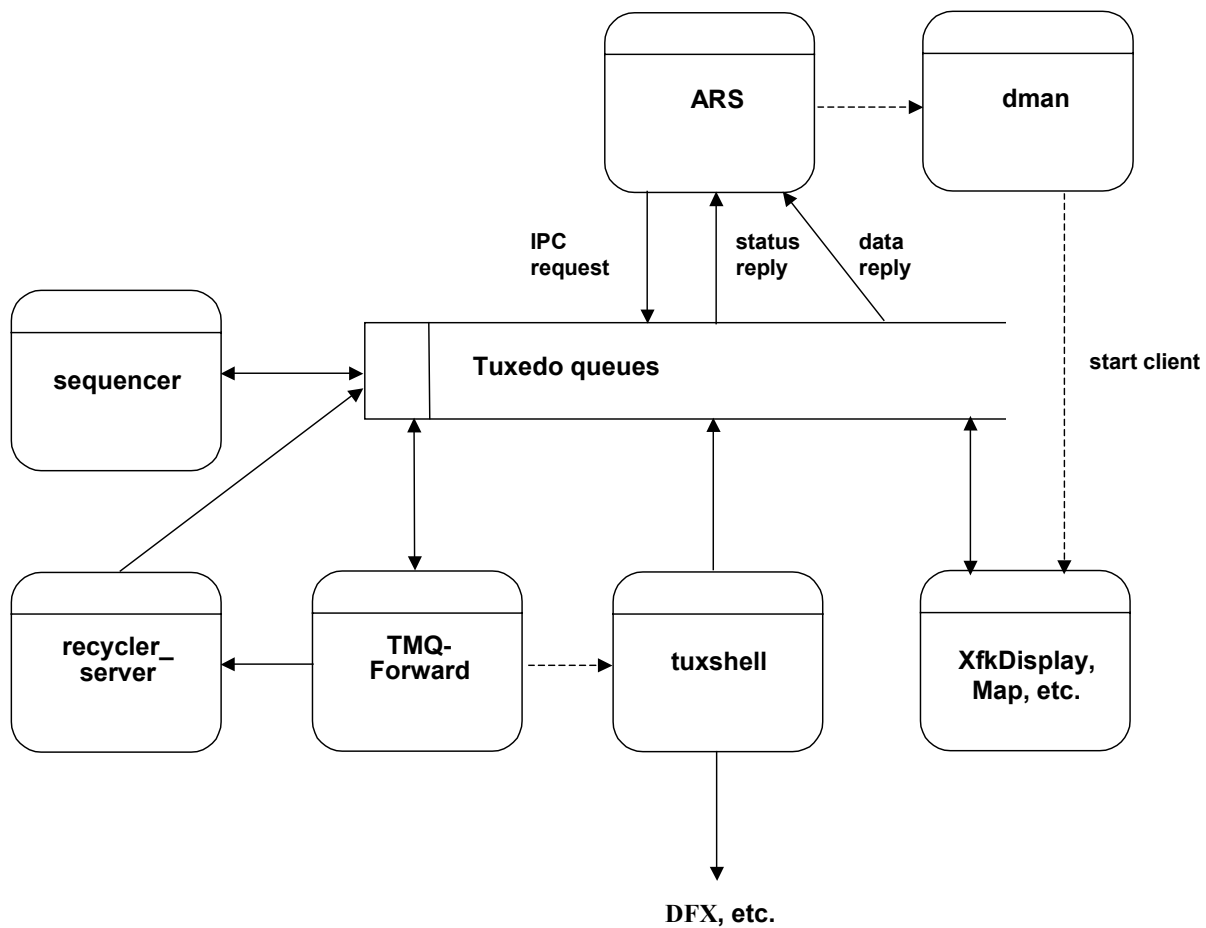


Figure 31. Tuxedo-based Distributed Application Support in Interactive Processing

4.2.6.1.2 Global Pipeline

The Global pipeline transforms raw waveforms into alphanumeric event data in nine stages of automated and interactive data processing. Figure 32 shows the data flow within the Global pipeline.

Waveform and alphanumeric data are run through station processing and network processing to detect signals and form preliminary events, respectively. The resulting automated bulletin is then analyzed by the first and second Seismic Event Analysts (SEA1, SEA2) and then by the first and second Event Evaluation Analysts (EEA1, EEA2). Each of the first three analysis stages is followed by a stage of post-analysis processing (AUTO-AL1, AUTO-AL2, AUTO-EVAL1). In addition, the evaluation stages include automated processing which is run after analyst review and before Discrimination analysis (called *Discrim* processing). The same applies to the analysis stages with the distinction that Discrimination analysis and the associated

automated processing are only performed on an as-needed basis for alerts. The processing is considered complete for the data in a time period when the data have been associated to events and the events are classified as far as possible by the EEA2.

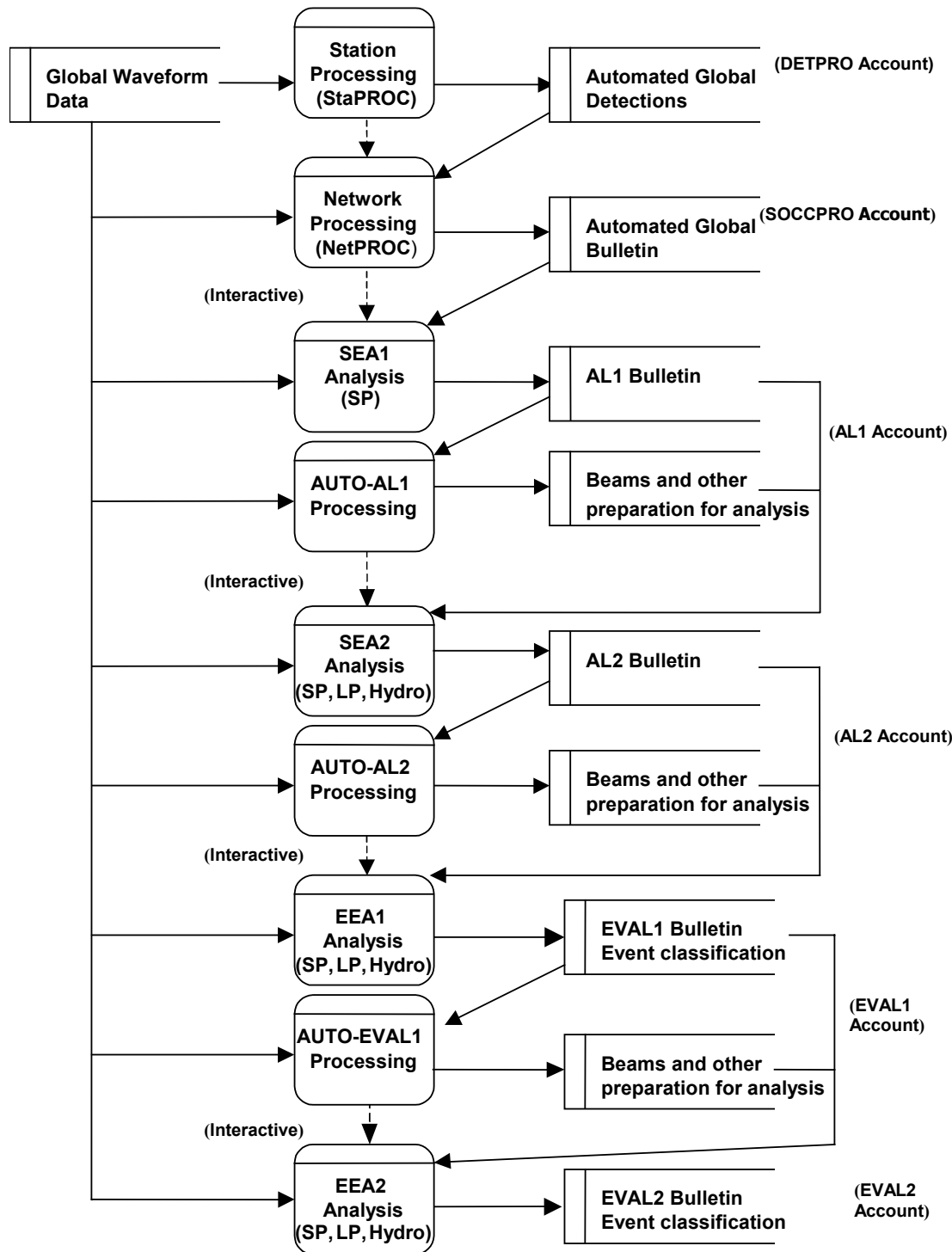


Figure 32. Global Pipeline Data Flow

4.2.6.1.2.1 Global Station Processing

Global station processing (*StaPROC*) is the first Global pipeline stage. Global station processing (see Figure 33) runs against seismic station (SEIS) intervals and treats each seismic station in isolation making detections, measurements, and beams according to the properties of the detections themselves. Information based on the network about events is not yet available at this stage of processing. Global station processing accomplishes all the processing that can be done at the station level. It also derives and writes to the database information about station and channel data quality and station noise levels.

The *seismic-tis-realtime* process monitors the incoming raw data in a candidate 15-minute time interval for a station. It creates an SEIS interval with a queued state in the global database account and initiates processing on the interval when 99.8% of the interval is covered by at least one station channel. If a candidate interval does not become 99.8% filled, but is 16% or more filled, then *seismic-tis-realtime* creates a partial interval. If the candidate interval does not become at least 16% filled, then *seismic-tis-realtime* creates a skipped interval.

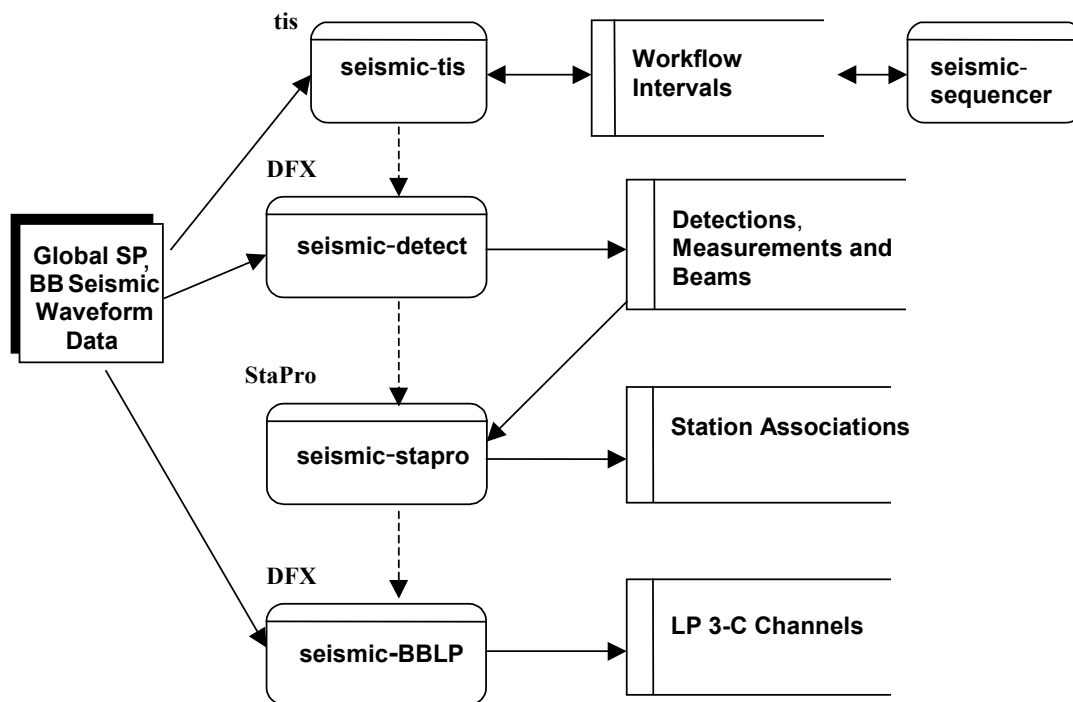


Figure 33. Global Station Processing Data Flow

When approximately 10 minutes have elapsed since a partial interval was created, which gave the Data Acquisition Subsystem a finite amount of time to fill in the time interval, *seismic-tis-partial* updates the interval state to pending, and *seismic-tis-realtime* initiates processing on the interval. If a skipped interval becomes at least 16% filled, *seismic-tis-late* updates the interval

state interval to pending or partial as appropriate and *seismic-tis-realtime* initiates processing on the interval.

The *seismic-sequencer* process schedules and controls the following sequence of processes to be run on each SEIS interval marked queued by the *seismic-tis-realtime* process. As the processing is performed, the *seismic-sequencer* updates the interval state to show the current active process in the sequence. When processing is completed, *seismic-sequencer* sets the interval state to station-done. If one of the processes fails, then *seismic-sequencer* attempts to rerun the process. If the process fails a second time, then *seismic-sequencer* sets the interval state to failed.

The *seismic-detect* process creates arrival records for valid signals detected on seismic stations. These records contain information such as the arrivals' onset time, SNR, amplitude, and period. It then attempts to generate a 5-minute arrival beam around each arrival, to correspond to the feature measurements made on the arrivals. For array stations, the beam is based on the azimuth and slowness determined from the arrival f-k spectrum. When there is less than 5 minutes of waveform data it is left to the global pipeline network processing stage to generate shorter duration arrival beams. For ASN stations detection processing runs against the broadband (BB) waveform data for the station, or both the BB and SP data, depending on the station.

The *seismic-stapro* process groups together arrivals for each station that can reasonably be presumed to have a common origin. The grouping together of arrivals is made on the basis of azimuth and slowness for array and three-component sites as well as on the basis of time of arrival for single-component stations. This station grouping lessens the likelihood that network association processing creates false multiple events using later arrivals from a single origin.

The *seismic-BBLP* process applies filters to derive true LP waveforms from BB waveforms for stations that do not transmit the LP channels. The LP arrays' center element is transmitted as a BB channel making it unsuitable for LP interpretation. This process creates LP channels consistent with the other LP array elements suitable for interpretation of surface waves (LQ and LR). Only a subset of the stations in the global network are configured for this processing.

4.2.6.1.2.2 Global Network Processing

Global network processing (*NetPROC*) is the second Global pipeline stage. Global network processing (see Figure 34) occurs when station processing has completed for a network-processing (NET) interval. The processing assembles the detection data from the available stations to produce event locations based on multiple stations.

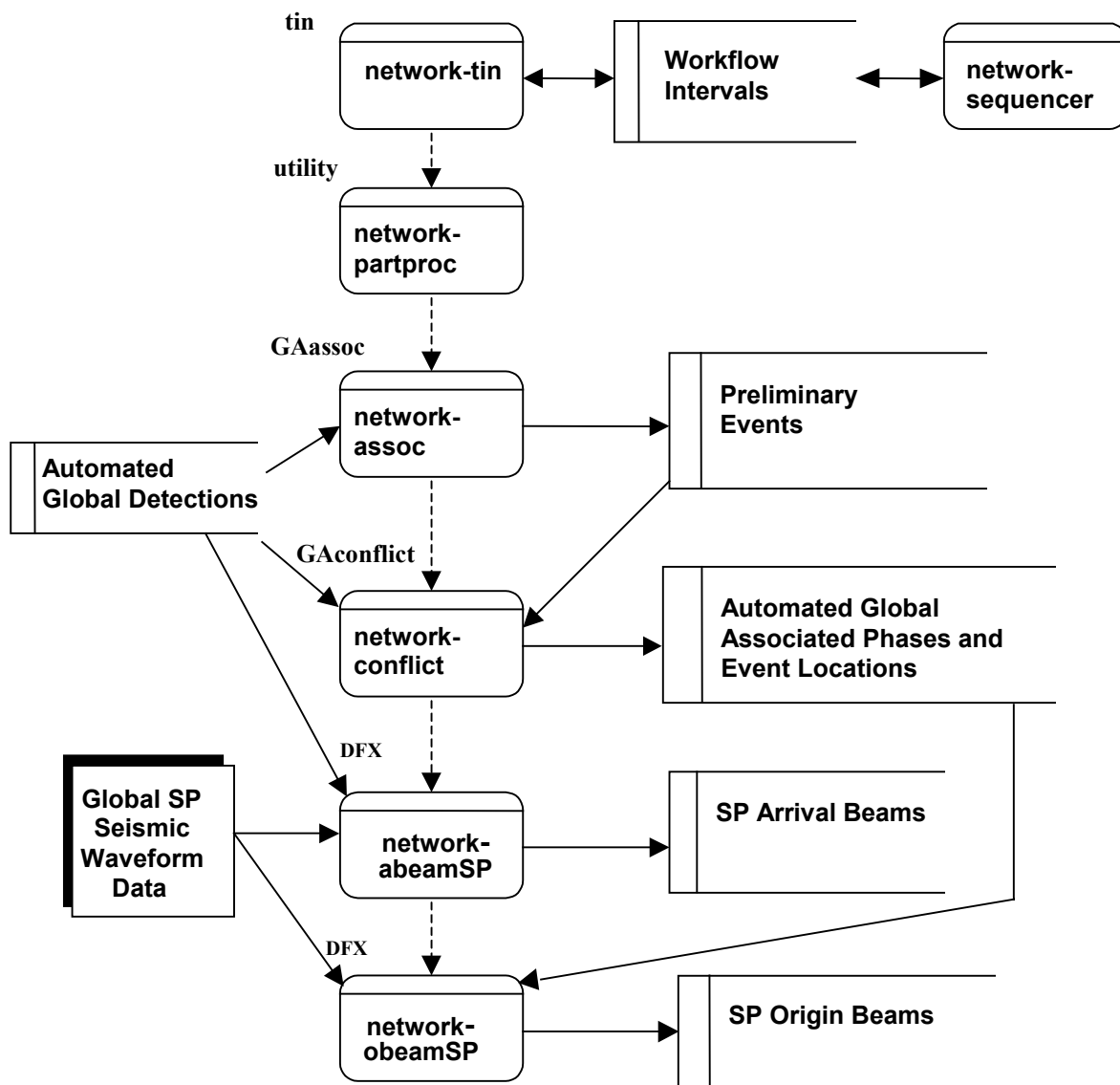


Figure 34. Global Network Processing Data Flow

The *network-tin* process monitors the number of completed station processing intervals in a candidate 30-minute time interval, creates a NET interval in the global database account, and initiates network processing when the number reaches the configured threshold. After an initial wait time of 30 minutes, network-tin creates the interval if station processing has completed for 100% of the stations in the network. If fewer than 100% of the stations in the network are completed, additional 5-minute waits occur as necessary while lowering the threshold on completed station processing to 75%, 50%, 25%, and finally to the minimum number of stations required forming an event. After 60 minutes, if station processing has completed for less than the minimum number of stations required forming an event, the candidate time interval is skipped.

The *network-sequencer* process schedules and controls the following sequence of processes to be run on each NET interval marked queued by the *network-tin* process. As the processing is performed, the network-sequencer updates the interval state to show the current active process in the sequence. When processing is completed, *network-sequencer* sets the state of the interval to network-done. If one of the processes other than the *network-conflict* process fails, then *network-sequencer* attempts to rerun the process. If the process fails a second time, the *network-sequencer* sets the interval state to fail.

The *network-partproc* process initiates station processing on all partial station intervals within the network interval. When the *seismic-tis-realtime* process determines that an interval is less than 100% filled, it creates a partial interval. While normally a waiting period elapses before the interval is processed, (to allow data acquisition additional time to receive any available data), *network-partproc* is used to stop the wait so that station processing proceeds on the partial intervals. Then *network-partproc* waits up to 5 minutes for any active station processing within the network interval to complete.

The *network-assoc* (*GAassoc*) and *network-conflict* (*GAconflict*) processes are collectively known as GA. The network interval processed represents the time period of arrivals to be associated together. GA applies a look-back of 20 minutes to the interval start time to account for the event origin times of any associated arrivals in the interval. GA produces seismic origins by associating three or more station detections and writes the results to the SOCCPRO database account.

The *network-assoc* process associates seismic detections to events and locates the events. It takes the detection data provided by station processing and uses an algorithm to group the detections into events. The output is a preliminary set of event data stored in the working tables **origin_ga**, **origerr_ga**, and **assoc_ga**, for refinement by the *network-conflict* process.

The *network-conflict* process resolves conflicts between the set of events contained in the working tables produced by *network-assoc* and the set of events found in the output origin, origerr, and assoc tables. Resolutions are made for events that overlap and detections that are associated to the wrong event. While resolving conflicts, it also adds defining phases to events where the detections match parameterized constraints. It then outputs the merged results to the origin, origerr, and assoc database tables.

When the *network-assoc* process first becomes active, it changes the state of the set of station processing time intervals covered by the network processing time interval from station-done to assoc-started. This shows which station processing intervals were completed in time for incorporation into the event bulletin produced by network processing. When the *network-conflict* process completes, it changes the same set of station processing time intervals' state to network-done. Station processing intervals which did not complete in time for network processing do not change the state from station-done to network-done unless there were no arrivals produced by the processing.

The *network-abeamSP* process creates arrival beams for arrivals that do not already have 5-minute-long beams as configured in station processing. When constrained by the length of available waveform data, the *network-abeamSP* process relaxes the time requirement and creates

shorter duration arrival beams. Forming some of the arrival beams during network processing allows the data acquisition additional time to receive all available data and increases the probability of consistently creating 5-minute-long arrival beams.

The *network-obeamSP* process forms SP origin beams for non-detecting stations for the set of events covered by a network interval. The term origin beam is used to indicate a beam whose parameters are based upon the event location rather than on an arrival's characteristics. In the absence of any other information, the origin beam should be optimal for detection of arrivals from that origin. For the stations that do not have an initial P detection associated to an event, the processing determines the theoretical time for arrivals expected from each event/station pair and forms the beam from waveform data around the theoretical time. The processing can be configured so that SP origin beams are formed only for events that meet specific criteria.

4.2.6.1.2.3 SEA1 Analysis

SEA1 Analysis is the third Global pipeline stage. SEA1 Analysis is used to review and refine the event solutions generated by the Automated Processing System, using all available SP data. When global network processing has completed five 30-minute intervals, the SEA1 analyst can begin to process the 2-hour block covering the first four network intervals.

The SEA1 analyst starts with a read of the data into the Analyst Review Station, which creates an *ARS* AL1 interval. The analyst reviews the events formed by network processing and refines arrival and event data as necessary. When the SEA1 analyst issues the **Save Data** command, *ARS* saves the remaining unassociated arrivals to the AL1 account, automatically creates a post-analyst processing AUTO-AL1 interval in the global account, and initiates AUTO-AL1 processing on the interval.

ARS computes up to three possible solutions for the event location (surface location, restrained location, and free location) and the corresponding magnitudes and saves them to the database. Locations redundant with an analyst-restrained location are not saved. For example, if the analyst-restrained location is at the surface, then no surface location is added. The triple-location results may be used as an aid to event classification. The solutions can be read/accessed and used by subsequent processes in AUTO-AL1 and AL2.

The input to SEA1 analysis is the Automated Bulletin in the SOCCPRO database account (accessed through the *in_** synonyms in the AL1 account) and any results that were saved in the AL1 account during a previous SEA1 analysis session for the same interval or for the adjacent intervals. Information in the AL1 account regarding a particular event, arrival, etc., takes precedence over the same information found in the SOCCPRO account.

In SEA1 analysis, event solutions are obtained using a multi-stage iterative procedure during which the origins are refined and augmented by:

- Locating the event
- Adjusting existing detections (associating, re-timing, renaming, etc.)
- Adding new arrivals

- Making arrivals defining/non-defining for location/magnitude
- Relocating the event to include the additional/modified information
- Verifying that the additional/modified information is consistent with the event

Other interactive processing tools are available to the analyst at this stage, although they are not routinely used. The *Discrim* process can be run on an as-needed basis for alerts. Also, *DFX* can be run in recall processing mode, as needed, to create and save origin beams and make and save origin-based measurements.

4.2.6.1.2.4 AUTO-AL1 Processing

AUTO-AL1 processing is the third Global pipeline stage. AUTO-AL1 prepares the input data for the SEA2 analyst by creating all necessary beams and measurements based on the results saved by the SEA1 analyst (see Figure 35 and Figure 36). The processing also searches for hydroacoustic arrivals to associate to the oceanic events and estimates azimuths of arrivals from hydroacoustic station groups.

The *auto-sequencer* process schedules and controls the following sequence of processes to be run on each AUTO-AL1 interval in the global database account marked queued by *ARS*. As the processing is performed, *auto-sequencer* updates the interval state to show the current active process in the sequence. When processing is completed, *auto-sequencer* sets the interval state to done. If one of the processes fails, then *auto-sequencer* attempts to rerun the process. If the process fails a second time, then *auto-sequencer* sets the interval state to fail.

The *autoall-obeamSP* process creates SP origin beams for new events that were formed by the SEA1 analyst and updates any existing origin beams to account for potentially significant differences in beam-steering resulting from changes in event locations. The analyst does not routinely save any origin beams, since they are efficiently created in the post-analysis processing. The analyst, however, has the capability to make and save origin beams and origin-based measurements through *DFX* recall as needed, in which case such results cannot be overwritten during the *autoall-obeamSP* process. The processing makes noise P phases and measures the noise amplitude and period at the theoretical time, for non-detecting stations in the appropriate distance range. The noise measurements are used to help estimate the maximum-likelihood body-wave magnitude for an event. Since up to three origins (from triple locations if they exist) are now routinely saved to the database for each event in the AL1 account, the *autoall-obeamSP* process now makes up to three sets of origin beams and origin-based amplitude and period measurements, one for each origin.

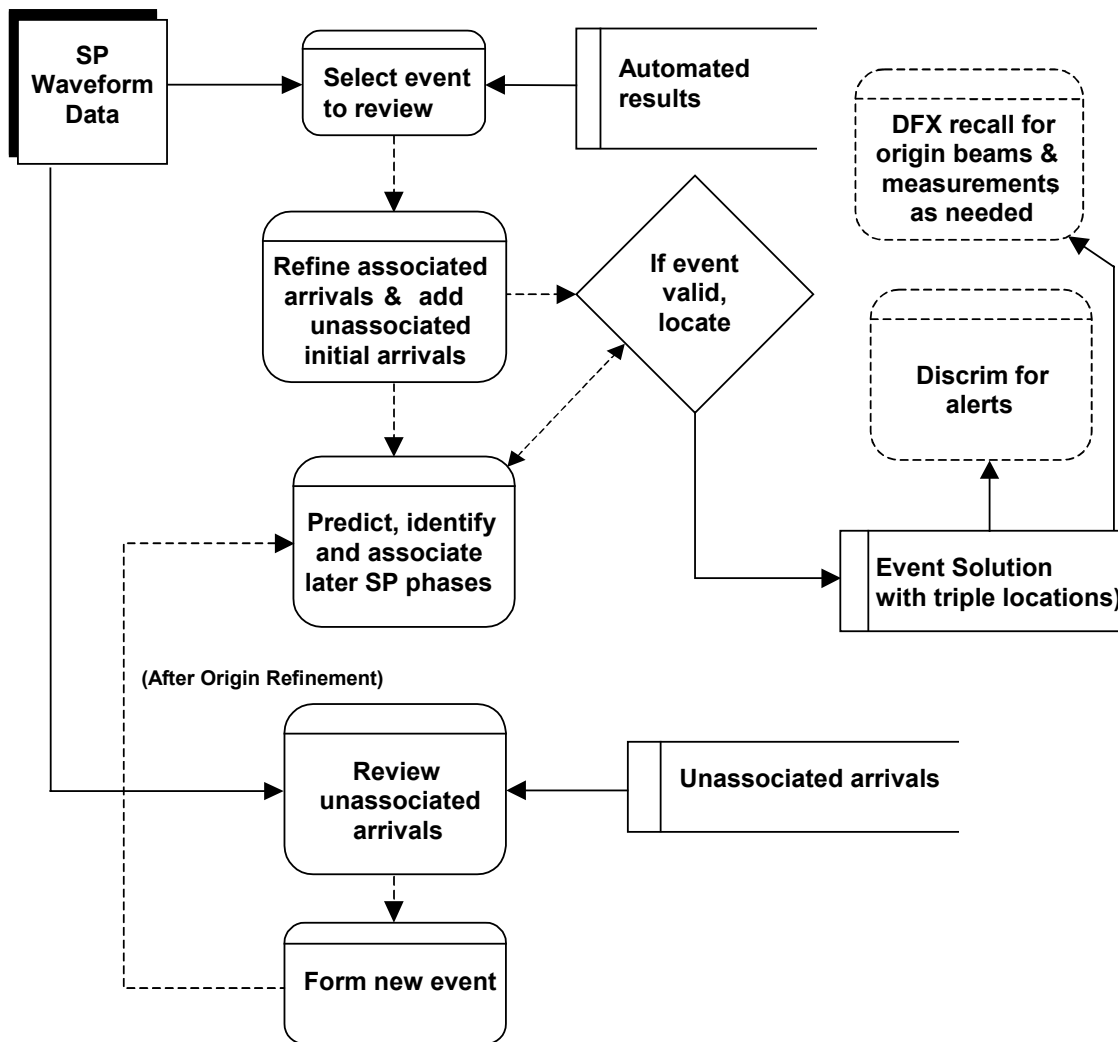


Figure 35. SEA1 Analysis Process Flow

The *autoall-obeamLP* process creates LP origin beams around the predicted arrival times of the LQ and LR surface wave phases for the origins saved in the AL1 account. Vertical and transverse beams are created for analysis of Rayleigh and Love waves, respectively.

The *autoall-autorecall* process makes signal measurements for arrivals added by the analyst during the AL1 analysis stage. It saves measurements to the database that were missing when the analyst saved the corresponding event and does not overwrite analyst results. When an analyst adds an arrival, SNR is available and any measurement that the analyst does not make is missing. The analyst may run *DFX* recall interactively to fill the missing database fields but, to save time, often does not do so. The *autoall-autorecall* process insures that all measurements made for automated detections are also available, for performance evaluation purposes, for analyst-added phases. It searches for arrivals with a SNR field set to NULL in the **arrival** database table. For such arrivals it calculates and populates the SNR field and any other field that is set to NULL. If the amplitude and period fields are thus populated, the

arrivalamp table is also updated accordingly. The *autoal1-autorecall* process makes signal measurements using automated detection and signal processing recipes.

The *autoal1-abeamSP* process creates arrival beams for arrivals that do not already have 5-minute-long beams as configured in station processing. When constrained by the length of available waveform data, the *autoal1-abeamSP* process relaxes the time requirement and creates shorter duration arrival beams. The analyst does not routinely save any arrival beams, since they are efficiently created in the post-analysis processing.

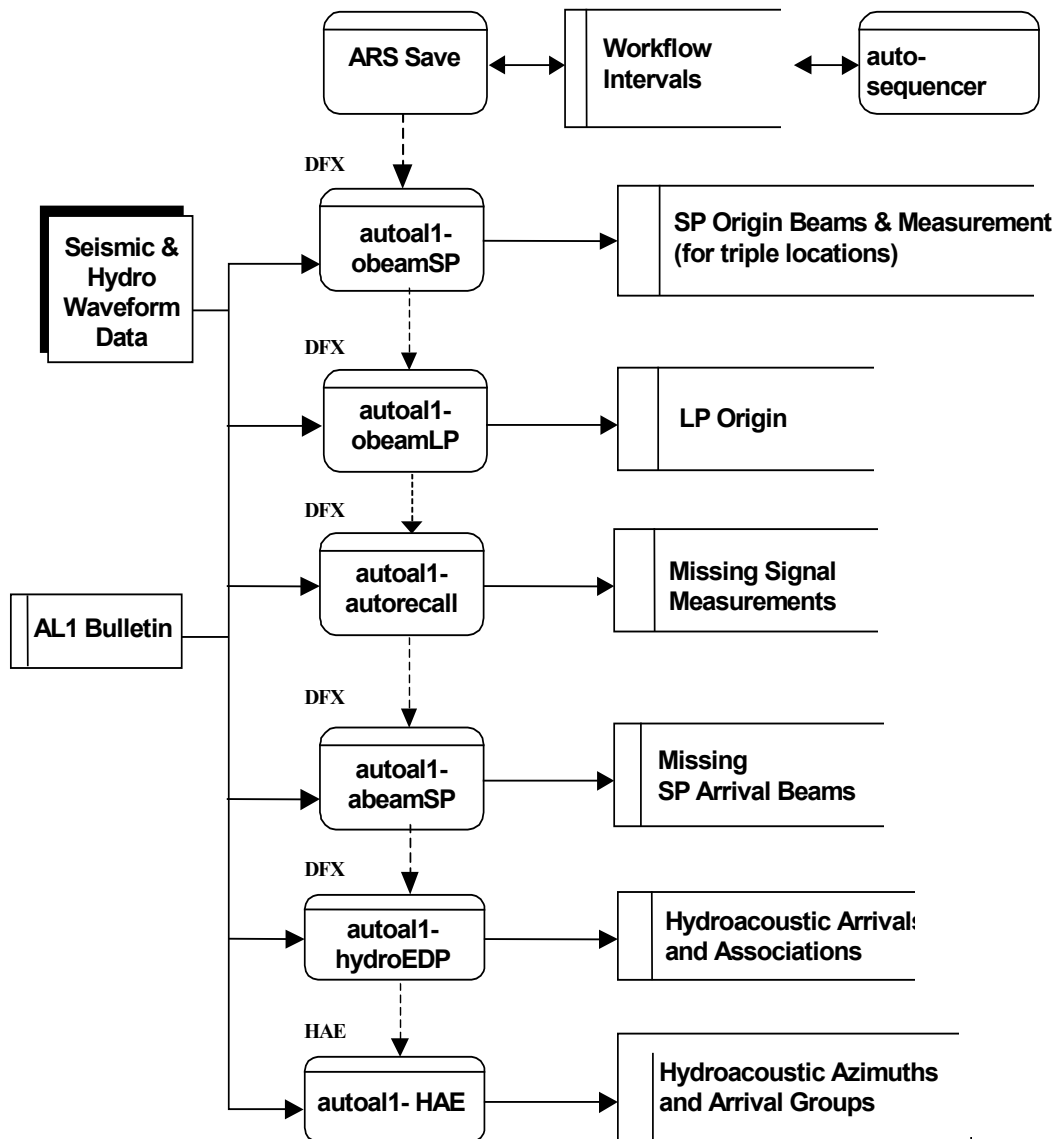


Figure 36. AUTO-AL1 Processing Data Flow

The *autoall-hydroEDP* process identifies hydroacoustic signals produced by earthquakes or other events under the ocean's surface. Hydroacoustic phases travel comparatively slowly and may arrive at sensors many minutes or hours after the seismic phases have all been received. Thus, an accurate seismic location can sometimes be used to predict hydroacoustic arrivals in advance. For the set of offshore seismic events covered by an *ARS* AL1 interval, the event driven processing (EDP) calculates the theoretical arrival times for hydroacoustic phases and then attempts to find hydroacoustic detections based on those predictions. Arrivals meeting appropriate criteria are then associated with the events and written to the AL1 database.

The *autoall-HAE* process groups arrivals belonging to the same event, based on their relative arrival times, for hydroacoustic stations in a given station group (e.g., Diego Garcia South). It then estimates an azimuth (two possible azimuths in the case where only two stations contribute) and the results are saved in the AL1 account.

4.2.6.1.2.5 SEA2 Analysis

SEA2 analysis is the Global pipeline's fifth stage. The primary goal in SEA2 analysis is to review and refine the event solutions generated by the SEA1 analyst. SEA2 analysis (see Figure 37) differs from SEA1 analysis primarily in that the SEA2 analyst is provided with LP waveform data, hydroacoustic waveform data, and automated results to review, in addition to the SP data and SEA1 analysis results. SEA2 analysis includes all the steps in SEA1 analysis as well as the additional steps required to add LP phases, to review, edit and add hydroacoustic phases, and to make the associated amplitude and period measurements. In addition, the SEA2 analyst uses the new HART tool to review and refine the hydroacoustic azimuths and arrival groups formed by HAE and to add new azimuths and groups, in order to assist in the association of hydroacoustic arrivals with seismic events.

The SEA2 analyst starts with a read of the data into *ARS*, which creates an *ARS* AL2 interval in the global database account. The analyst reviews the events formed by the SEA1 analyst and refines arrival and event data as necessary. When the SEA2 analyst issues the **Save Data** command, *ARS* saves the remaining unassociated arrivals to the AL2 account, saves the event solutions including triple location and magnitude results, automatically creates a post-analysis processing AUTO-AL2 interval in the global account, and initiates AUTO-AL2 processing on the interval.

ARS computes up to three possible solutions for the event location (surface location, restrained location, and free location) and their corresponding magnitudes saves them to the database. Locations redundant with an analyst-restrained location are not saved. For example, if the analyst-restrained location is at the surface, then no surface location is added. The triple-location results may be used as an aid to event classification. The solutions can be read/accessed and used by subsequent processes in AUTO-AL2 and EVAL1.

The input to SEA2 analysis is the SEA1 Bulletin in the AL1 database account (accessed through the in_* synonyms in the AL2 account) and any results that were saved in the AL2 account during a previous SEA2 analysis session for the same interval or for the adjacent intervals. Information in the AL2 account regarding a particular event, arrival, etc., takes precedence over the same information found in the AL1 account.

In SEA2 analysis, event solutions are obtained using a multi-stage iterative procedure during which the origins are refined and augmented by:

- Locating the event
- Adding new arrivals
- Making arrivals defining/non-defining for location/magnitude
- Relocating the event to include the additional/modified information
- Verifying that the additional/modified information is consistent with the event

Other interactive processing tools are available to the SEA2 analyst, although they are not routinely used. The *Discrim* and *HydroDiscrim* processes that are normally run in the evaluation stages (EEA1 and EEA2) can also run at this stage on an as-needed basis to check for alerts. Also, *DFX* can run in recall processing mode, as needed, to create and save origin beams and make and save origin-based measurements.

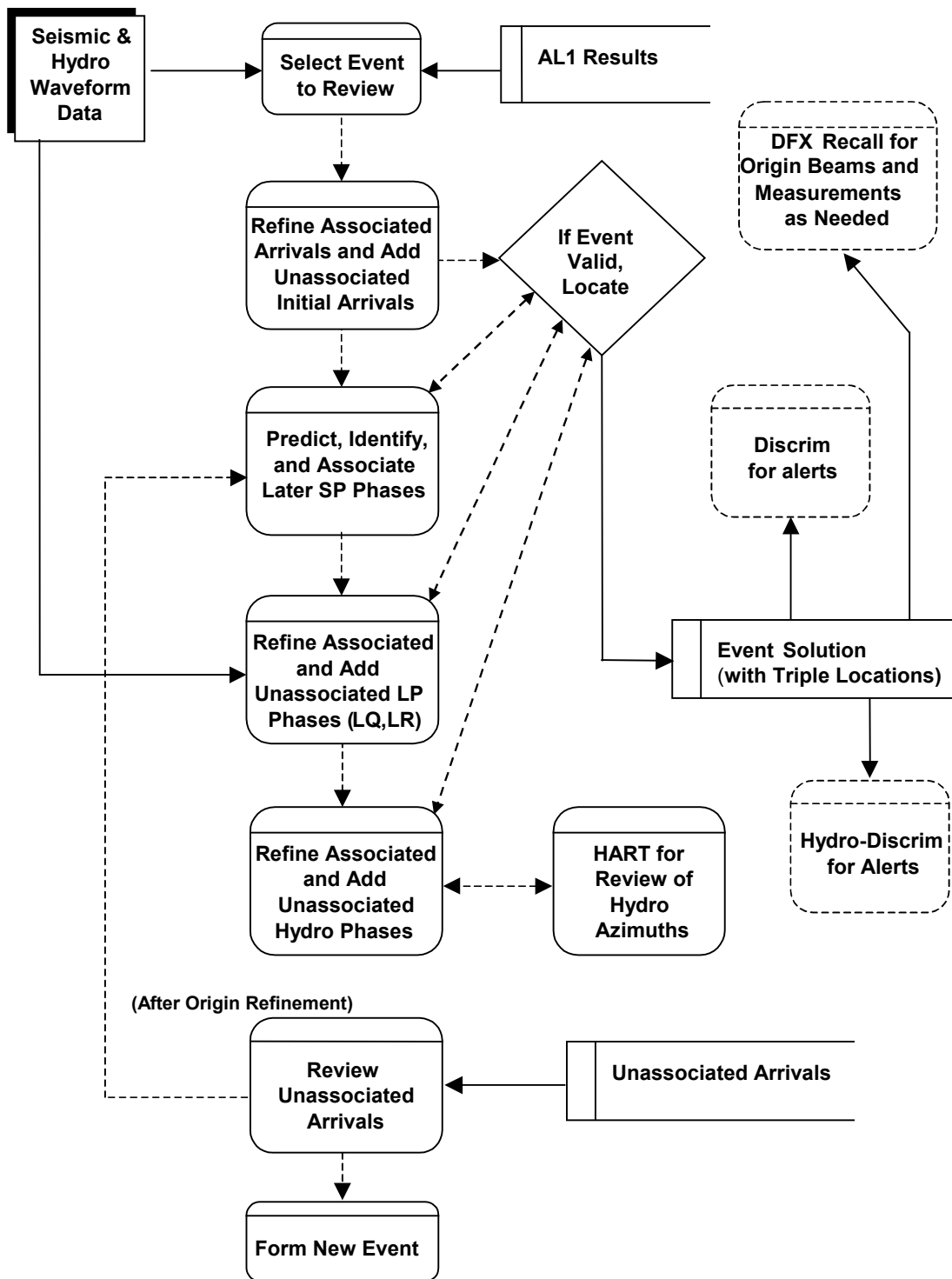


Figure 37. SEA2 Analysis Process Flow

4.2.6.1.2.6 AUTO-AL2 Processing

AUTO-AL2 processing is the Global pipeline's sixth stage. AUTO-AL2 processing (see Figure 38) prepares the input data for the EEA1 analyst by creating all necessary beams and measurements based on the results saved by the SEA2 analyst. The processing duplicates the AUTO-AL1 processes that create SP beams and LP origin beams, then adds processes to create noise phases and to determine the maximum-likelihood body-wave magnitudes for events.

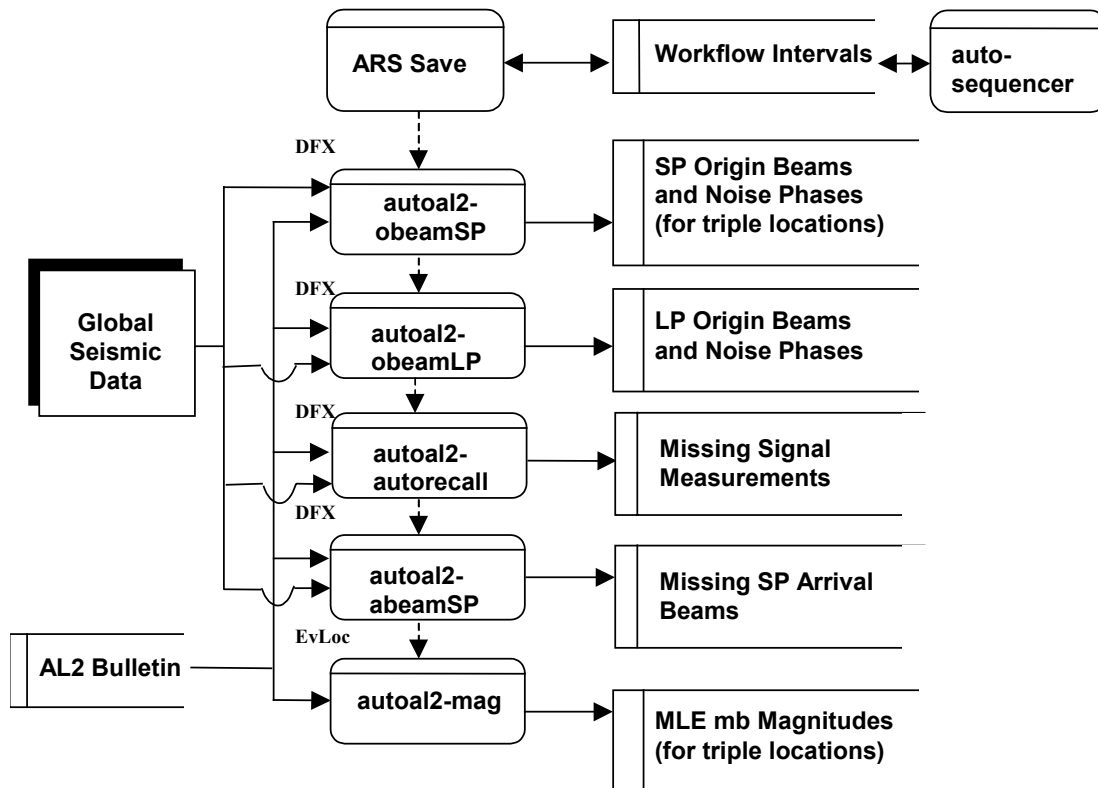


Figure 38. AUTO-AL2 Processing Data Flow

The *autoal2-obeamSP* process creates SP origin beams for new events that were formed by the SEA2 analyst and updates any existing origin beams to account for potentially significant differences in beam-steering resulting from changes in event locations. The analyst does not routinely save any origin beams, since they are efficiently created in the post-analysis processing. The processing makes noise P phases and measures the noise amplitude and period at the theoretical time, for non-detecting stations in the appropriate distance range. The noise amplitude measurements are used to help estimate the maximum-likelihood body-wave magnitude for an event. Since up to three unique origins (from triple locations) are now routinely saved to the database for each event in the AL2 account, the *autoal2-obeamSP* process now makes up to three sets of origin beams and origin-based amplitude and period measurements, one for each unique origin.

The *autoal2-obeamLP* process creates LP origin beams around the predicted arrival times of the LQ and LR surface wave phases for events saved in the AL2 account. Vertical and transverse beams are created for analysis of Rayleigh and Love waves, respectively.

The *autoal2-autorecall* process makes signal measurements for arrivals added by the analyst during the AL2 analysis stage. It saves measurements to the database that were missing when the analyst saved the corresponding event and does not overwrite analyst results. When an analyst adds an arrival, no SNR is available and any measurement that the analyst does not make is missing, as well. The analyst may run *DFX* recall interactively to fill the missing database fields, but often does not do so to save time. The *autoal2-autorecall* process insures that all measurements made for automated detections are also available, for performance evaluation purposes, for analyst-added phases. It searches for arrivals with a SNR field set to NULL in the **arrival** database table. For such arrivals, it calculates and populates the SNR field and any other field that is set to NULL. If the amplitude and period fields are thus populated, the **arrivalamp** table is also updated accordingly. The *autoal2-autorecall* process makes signal measurements using recipes from automated detection and signal processing.

The *autoal2-abeamSP* process creates arrival beams for arrivals that do not already have 5-minute-long beams as configured in station processing. When constrained by the length of available waveform data, the *autoal2-abeamSP* process relaxes the time requirement and creates shorter duration arrival beams. The analyst does not routinely save any arrival beams, since they are efficiently created in the post-analysis processing.

The *autoal2-mag* process utilizes noise measurements to compute the maximum-likelihood body-wave magnitudes for events. Incorporating the measurements of noise level at stations that did not report arrivals improves the magnitude estimate. The *autoal2-mag* process now computes and saves up to three maximum-likelihood magnitudes sets for each event, one for each unique origin from triple location.

4.2.6.1.2.7 EEA1 Analysis

EEA1 analysis is the Global pipeline's seventh stage. EEA1 analysis (see Figure 39) differs from SEA2 analysis primarily in that the EEA1 analyst also classifies the area of interest (AOI) event solutions into event types, using all available waveform data sources including hydroacoustic data, while this function is only performed in the SEA1 and SEA2 analysis stages as needed for alerts.

The EEA1 analyst starts with a read of the data into *ARS*, which creates an *ARS* EVAL1 interval. The analyst reviews the events formed by the SEA2 analyst and refines arrival and event data as necessary. When the EEA1 analyst issues the **Save Data** command, *ARS* saves the remaining unassociated arrivals to the EVAL1 account, saves the event solutions including triple location and magnitude results, automatically creates a post-analyst processing AUTO EVAL1 interval in the global account, and initiates AUTO-EVAL1 processing on the interval.

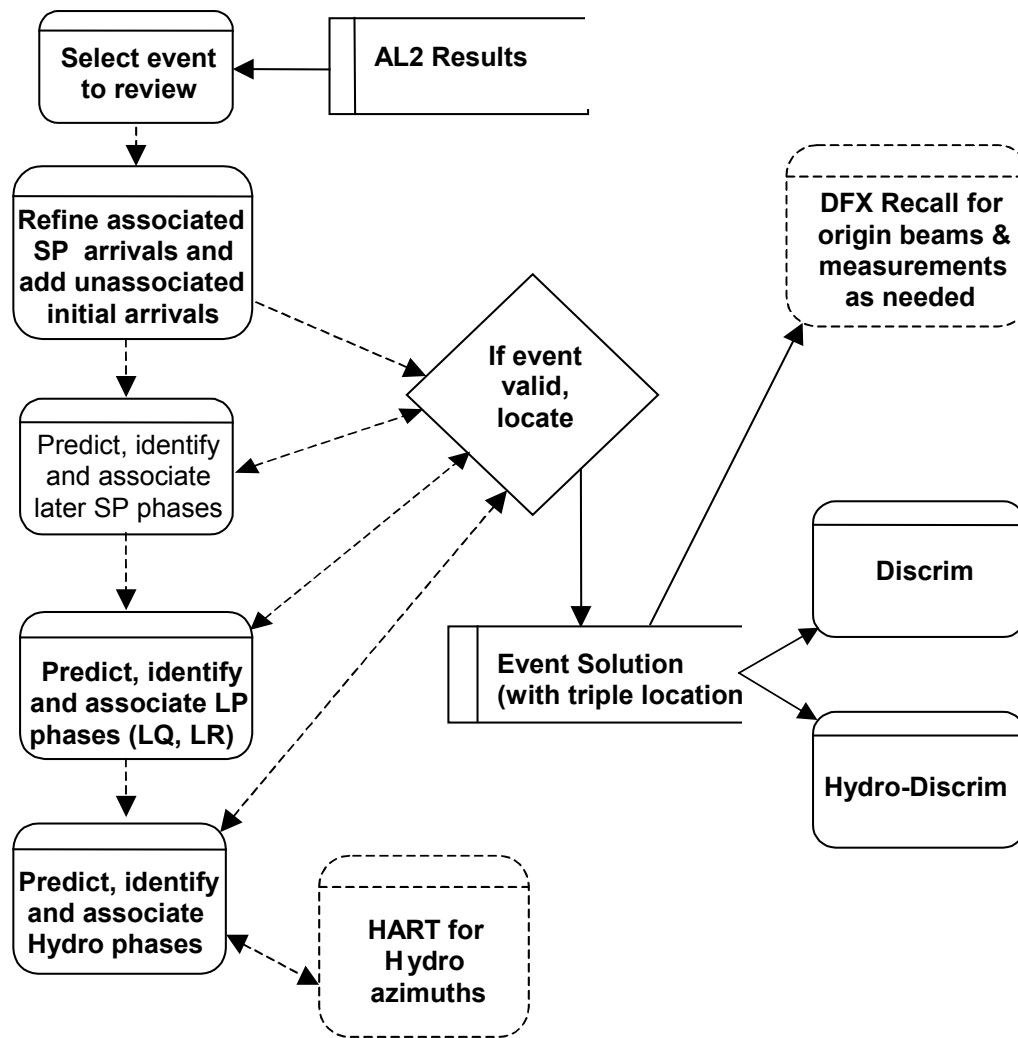


Figure 39. EEA1 Analysis Process Flow

ARS computes up to three possible solutions for the event location (surface location, restrained location, and free location) and the corresponding magnitudes and saves them to the database. Locations redundant with an analyst-restrained location are not saved. For example, if the analyst-restrained location is at the surface, then no surface location is added. The triple-location results may be used as an aid to event classification. The solutions can be read/accessed and used by subsequent processes in AUTO-EVAL1 and EVAL2.

The input to EEA1 analysis is the SEA2 Bulletin in the AL2 database account (accessed through the in_* synonyms in the EVAL1 account) and any results that were saved in the EVAL1 account during a previous EEA1 analysis session for the same interval or for the adjacent intervals. Information in the EVAL1 account regarding a particular event, arrival, etc., takes precedence over the same information found in the AL2 account.

In EEA1 analysis, event solutions are obtained using a multi-stage iterative procedure during which the origins are refined, augmented, and finally classified by the following:

- Distinguishing between events in AOI and outside areas of interest (OAI)
- Saving the final event solution as appropriate for the AOI or OAI events
- Initiating Discrim analysis on AOI events
- Initiating *Hydro-Discrim* analysis on oceanic AOI events

Other interactive processing tools are available to the EEA1 analyst, although they are not routinely used. *DFX* can be run in the recall processing mode, as needed, to create and save origin beams and make and save origin-based measurements. Also, the EEA1 analyst can use the new HART tool to review and refine existing hydroacoustic azimuths and arrival groups and to measure azimuths for new hydroacoustic arrival groups formed in the *ARS*, in order to assist in the association of hydroacoustic arrivals with seismic events.

4.2.6.1.2.7.1 Discrim Automated Processing

The *Discrim* application requires a specific set of measurement at all available stations for an event and certain *Discrimination*-specific database tables need to be filled in. Therefore, when an analyst selects the *Discrim* button in the *ARS* menu bar an automated processing pipeline is invoked (see Figure 40) to prepare all the needed information.

The *Discrim-sequencer* process schedules and controls the following sequence of processes to be run on a saved event. When the sequence is completed it then starts or updates the *Discrim* application itself. The *Discrim-sequencer* does not rerun processes automatically when a failure is encountered.

The *Discrim-origbeamSP* process makes SP origin beams and noise measurements from the beams.

The *Discrim-classampSP* process makes SP classification measurements of several types of amplitude, period, signal, and noise in various time windows from the arrival beam.

The *Discrim-classampSPo* process makes classification amplitude measurements on the SP horizontal origin beam the analyst saved.

The *Discrim-origbeamLP* process makes LP origin beams and noise measurements from the beams.

The *Discrim-origampNL* process measures the LP noise level in a window preceding the predicted primary arrival (P or PKP_{df}) for a station, which has no LP phases (LR or LQ) associated. The purpose is to measure a noise level before the event with which the noise amplitude measured at the predicted time for LR can be compared.

The *Discrim-msnmag* process determines the maximum-likelihood surface-wave noise magnitude (Msn) for an event, using noise measurements at stations without surface wave amplitude measurements.

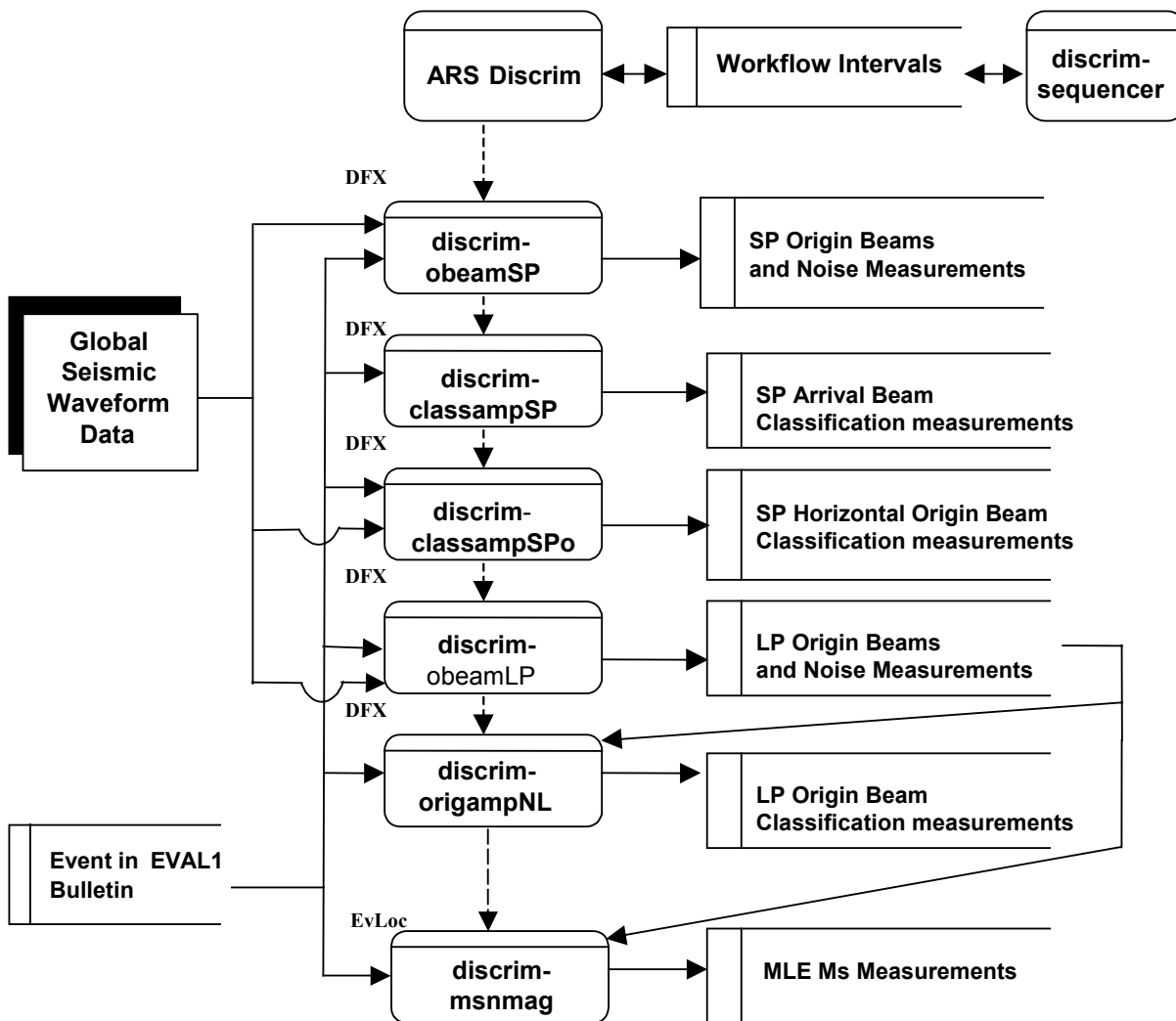


Figure 40. *Discrim* Automated Processing Data Flow

4.2.6.1.2.7.2 Discrim Analysis

The purpose of *Discrim* analysis is to verify and, when necessary, modify the individual classification measurements and final votes for seismic observations. *Discrim* analysis (see Figure 41) is conducted for AOI and noteworthy OAI events. The *Discrim* program itself lies at the *Discrim* Automated Processing pipeline end, which creates beams and computes the numerous measurements needed for event classification using seismic observations (e.g., the pre-P LP noise measurement made on the LP origin beam). Therefore, it is necessary that arrival onset time adjustments and other event refinements be completed before initiating this processing.

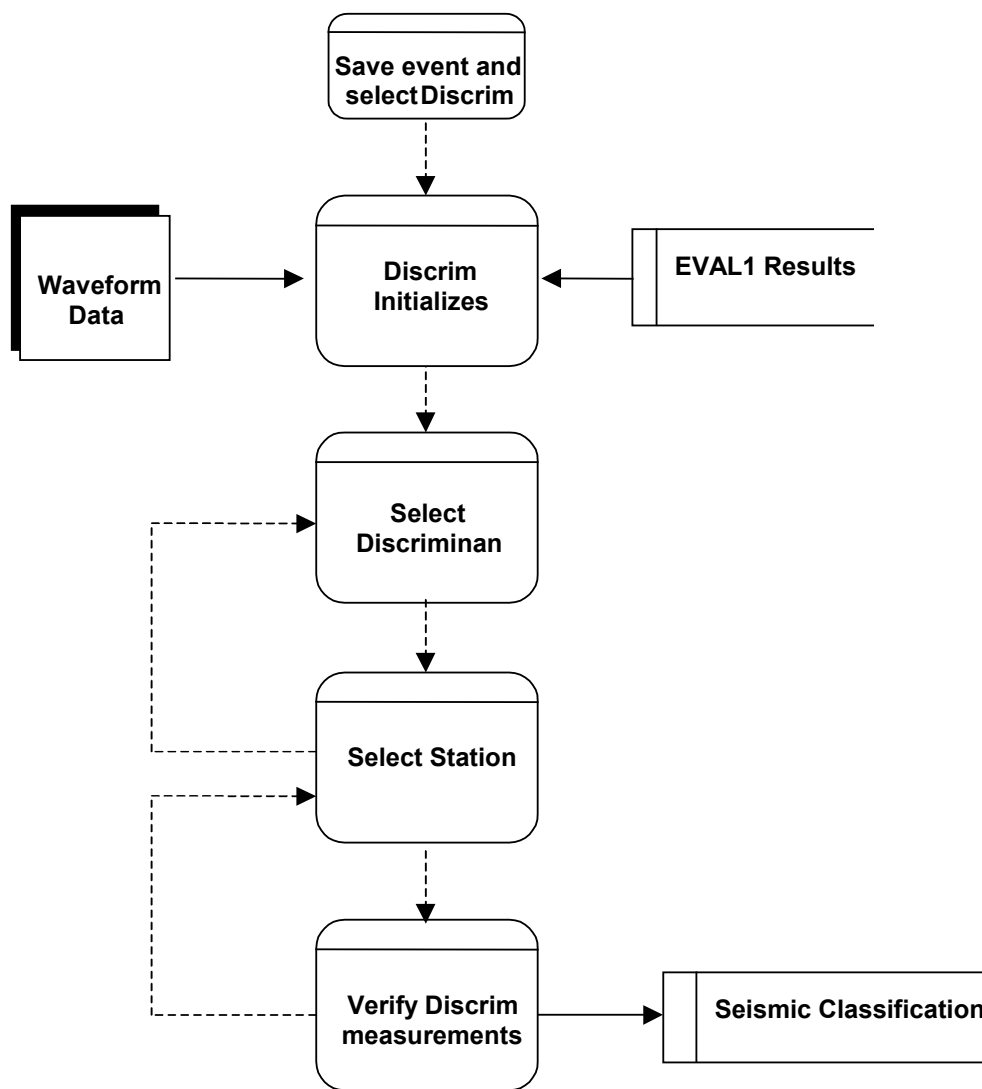


Figure 41. *Discrim* Analysis Process Flow

4.2.6.1.2.7.3 Hydro-Discrim Analysis

Hydro-Discrim analysis verifies, and when necessary, modifies the individual classification measurements and final votes for hydroacoustic observations. *Hydro-Discrim* analysis (see Figure 42) is conducted for oceanic AOI and noteworthy OAI events. Unlike *Discrim*, *Hydro-Discrim* is not preceded by automated processing. The **HDT** tool-bar item in *ARS* merely initiates a process that populates the necessary database tables, and invokes the hydrodisplay tool.

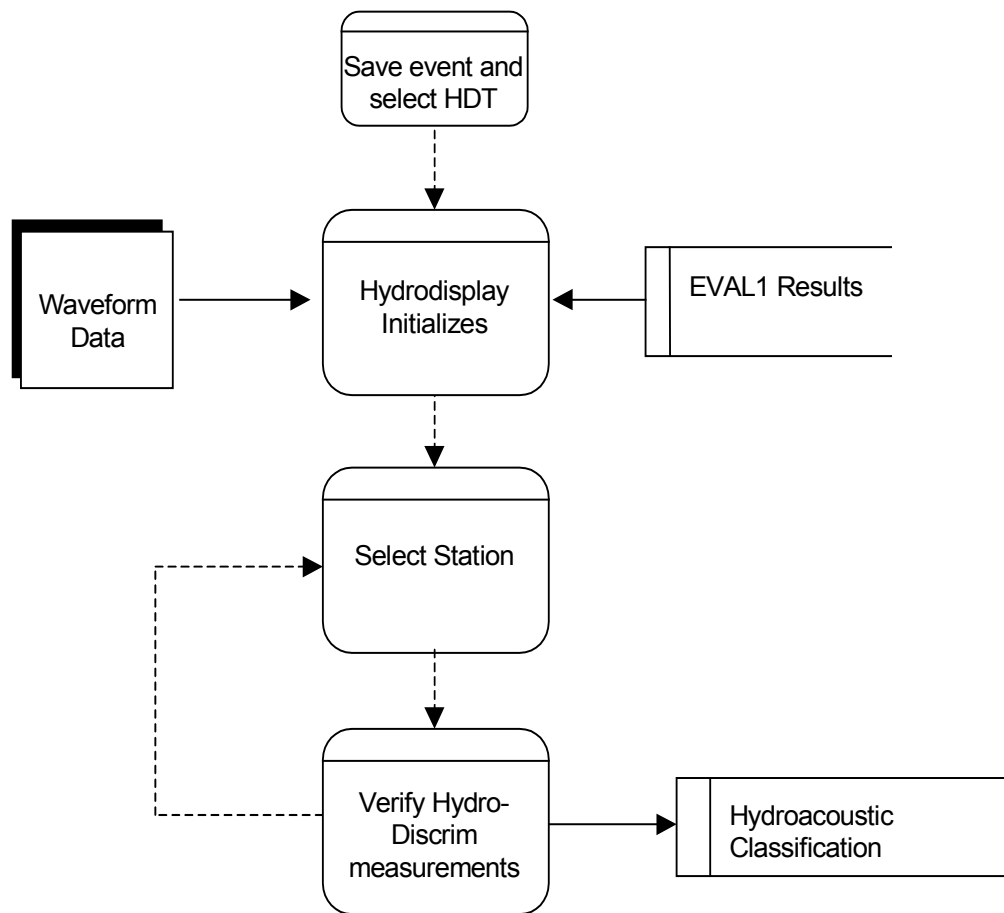


Figure 42. Hydro-*Discrim* Analysis Process Flow

4.2.6.1.2.8 AUTO-EVAL1 Processing

AUTO-EVAL1 processing is the Global pipeline's eighth stage. AUTO-EVAL1 processing (see Figure 43) prepares the input data for the EEA2 analyst by creating SP origin beams and noise measurements for AOI events and determining the maximum-likelihood body-wave magnitudes for events.

The *autoeval1-origbeamSP* process creates SP origin beams for new OAI events that were formed by the EEA1 analyst and updates any existing origin beams to account for potentially significant differences in beam-steering resulting from changes in event locations. The analyst does not routinely save any origin beams since they are efficiently created in the post-analysis processing. The processing makes noise P phases and measures the noise amplitude and period at the theoretical time for non-detecting stations in the appropriate distance range. The noise measurements are used to help define the maximum-likelihood body-wave magnitude for an

event. Since up to three origins (from triple locations) are routinely saved to the database for each event in the EVAL1 account, the *autoeval1-obeamSP* process makes up to three sets of origin beams and origin-based amplitude and period measurements, one for each unique origin.

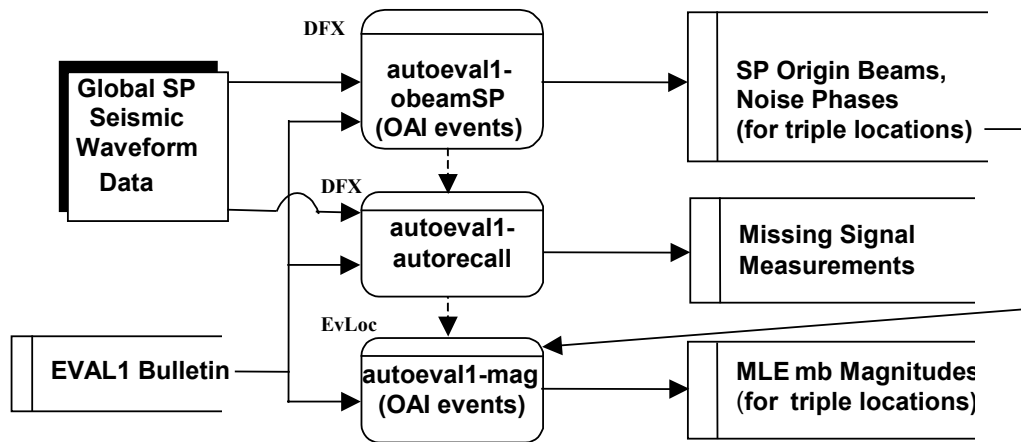


Figure 43. AUTO-EVAL1 Processing Data Flow

The *autoeval1-autorecall* process makes signal measurements for arrivals added by the analyst during the EVAL1 analysis stage. It saves measurements to the database that were missing when the analyst saved the corresponding event and does not overwrite analyst results. When an analyst adds an arrival, no SNR is available and any measurement that the analyst does not make is missing, as well. The analyst may run *DFX* recall interactively to fill the missing database fields, but often does not do so to save time. The *autoeval1-autorecall* process insures that all measurements made for automated detections are also available, for performance evaluation purposes, for analyst-added phases. It searches for arrivals with a SNR field set to NULL in the **arrival** database table. For such arrivals, it calculates and populates the SNR field and any other field that is set to NULL. If the amplitude and period fields are thus populated, the **arrivalamp** table is also updated accordingly. The *autoeval1-autorecall* process makes signal measurements using recipes from automated detection and signal processing.

The *autoeval1-mag* process utilizes noise measurements to compute the maximum-likelihood body-wave magnitudes for OAI events. Incorporating the measurements of noise amplitude at stations that did not report arrivals, improves the magnitude estimate.

4.2.6.1.2.9 EEA2 Analysis

EEA2 analysis is the Global pipeline's last stage. EEA2 analysis (see Figure 44) is similar to EEA1 analysis as the EEA2 analyst also classifies the AOI event solutions into event types, using all available waveform data sources including hydroacoustic data.

The EEA2 analyst starts with a read of the data into the *ARS*, which creates an *ARS* EVAL2 interval. The analyst reviews the events formed by the EEA1 analyst and refines arrival and

event data as necessary. When the EEA2 analyst issues the **Save Data** command, *ARS* saves the remaining unassociated arrivals to the EVAL2 account and saves the event solutions including triple location and magnitude results.

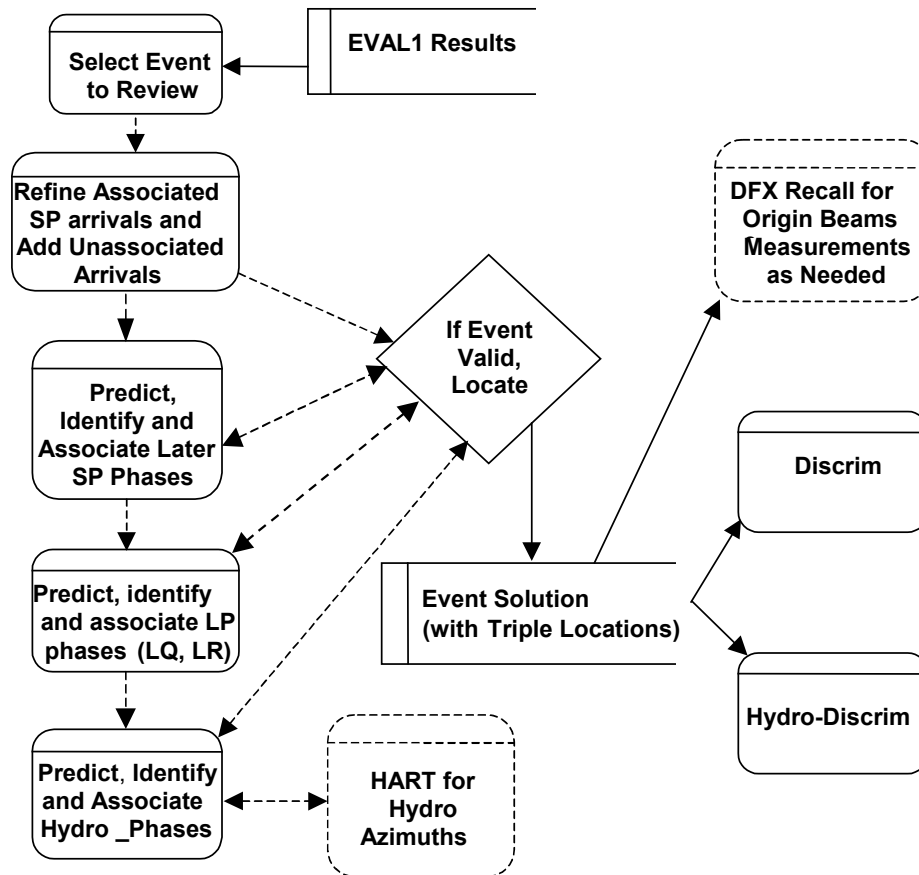


Figure 44. EEA2 Analysis Process Flow

ARS computes up to three possible solutions for the event location (surface location, restrained location, and free location) and their corresponding magnitudes and saves them to the database. Locations redundant with an analyst-restrained location are not saved. For example, if the analyst-restrained location is at the surface, then no surface location is added. The triple-location results may be used as an aid to event classification.

The input to EEA2 analysis is the EEA1 Bulletin in the EVAL1 database account (accessed through the in_* synonyms in the EVAL2 account), and any results that were saved in the EVAL2 account during a previous EEA2 analysis session for the same interval or for the adjacent intervals. Information in the EVAL2 account regarding a particular event, arrival, etc., takes precedence over the same information found in the EVAL1 account.

In EEA2 analysis, event solutions are obtained using a multi-stage iterative procedure during which the origins are refined, augmented, and finally classified by the following:

- Saving the final event solution
- Initiating *Discrim* analysis on AOI events
- Initiating *Hydro-Discrim* analysis on oceanic AOI events

Other interactive processing tools are available to the EEA2 analyst, although they are not routinely used. *DFX* can be run in recall processing mode as needed to create and save origin beams and make and save origin-based measurements. Also, the EEA2 analyst can use the new HART tool to review and refine existing hydroacoustic azimuths and arrival groups, and to measure azimuths for new hydroacoustic arrival groups formed in the *ARS*, in order to assist in the association of hydroacoustic arrivals with seismic events.

4.2.6.1.2.9.1 Global Pipeline Event Trace

Figure 45 shows a Global pipeline processing event trace. Table 41 provides an event trace description summary.

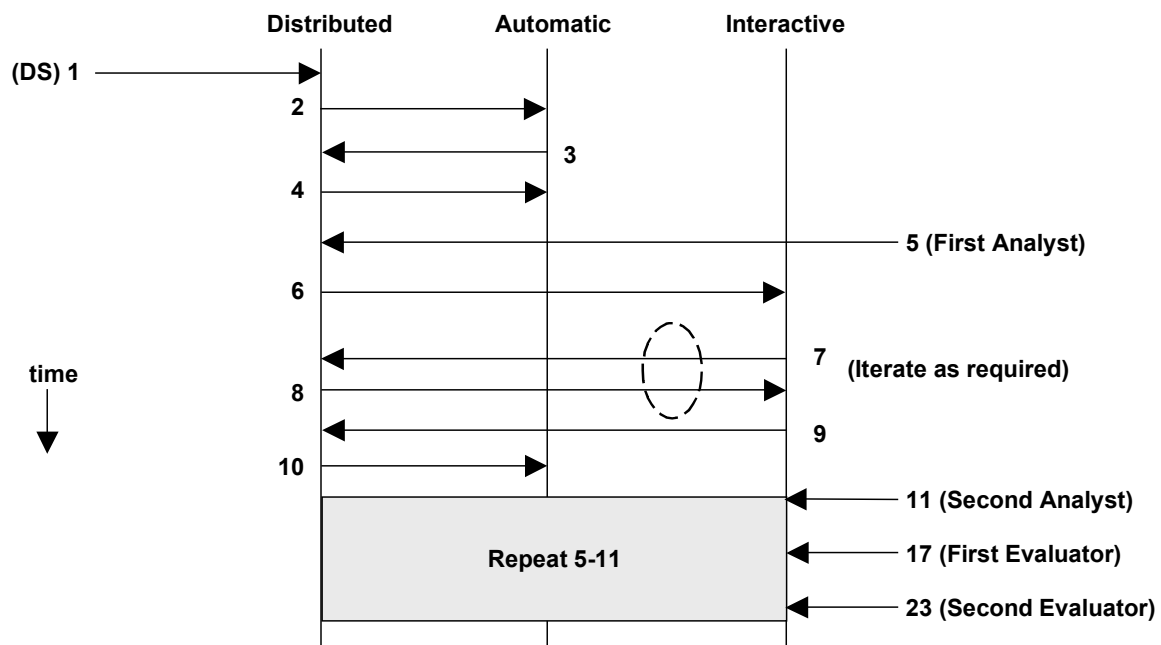


Figure 45. Global Pipeline Event Trace

Table 41. Global Pipeline Event Trace Description

EVENT NO.	CSCI	THREAD	EVENT TRIGGER	EVENT DESCRIPTION	PROCESSING FREQUENCY
1	Distributed	Station processing	Data services acquires sufficient waveform data for station(s) in interval.	DACS data monitor creates interval in interval table for station(s).	Continuous
2	Automatic	Station processing	DACS workflow monitor initiates station processing.	Station processing performed on data in interval and interval table updated.	1/station/ 15 min
3	Distributed	Network processing	Sufficient stations completed in interval or maximum time elapses.	DACS data monitor creates interval in interval table for network.	Continuous
4	Automatic	Network processing	DACS workflow monitor initiates network processing.	Network processing performed on data in interval and interval table updated.	1/network/ 30 min
5	Distributed	Analysis	Sufficient network processing completed in interval.	Analyst directed to start analysis after sufficient time elapse.	1/network/ 120 min
6	Interactive	Analysis	Analyst specifies time interval to analyze.	Analyst performs analysis on interval.	1/network/ 120 min
7	Interactive	Analysis	Analyst needs interactive processing for interpretation.	Analyst sends command to DACS to perform interactive processing during analysis.	1/process/ analyst session
8	Distributed	Analysis	Message received by DACS to start interactive processing.	DACS starts interactive processing tool(s).	1/process/ analyst session
9	Interactive	Analysis	Analyst completes analysis on interval.	Analyst sends message to DACS to perform post-interactive automated processing.	1/network/ 120 min
10	Automatic	Automated post-interactive processing	Message received by DACS to start post-analysis automated processing.	Post-analysis automated processing performed and interval table updated.	1/network/ 120 min

Table 41. Global Pipeline Event Trace Description (Continued)

EVENT NO.	CSCI	THREAD	EVENT TRIGGER	EVENT DESCRIPTION	PROCESSING FREQUENCY
11-16	All	Analysis (2) and automated post-analysis processing (2)	Analyst directed to start analysis after sufficient time elapse.	Second analysis pass repeats events 6 through 10.	1/network/ 120 min
17-22	All	Evaluation (1) and automated post-analysis processing (2)	Evaluator directed to start analysis after sufficient time elapsed.	First evaluation pass repeat events 6 through 10 except with evaluator input.	1/network/ 120 min
23-28	All	Evaluation (2) and automated post-analysis processing (2)	Evaluator directed to start analysis after sufficient time elapsed.	Second evaluation pass repeats events 6 through 10 except with evaluator input.	1/network/ 120 min

4.2.6.1.3 Spotlight Pipeline

The Spotlight pipeline produces alphanumeric event data from raw waveforms through one stage of automated and two stages of interactive data processing. Spotlight pipeline allows for continuous monitoring of areas of special concern using lower thresholds (e.g., relaxed event formation criteria). Multiple areas can be monitored through appropriate Spotlight pipeline configuration. Waveform and alphanumeric data are run through station processing to detect signals and to form preliminary single-station events. Unlike Global pipeline processing, Spotlight Pipeline has no network processing stage and only two interactive analysis stages. As a primary goal, the first Spotlight analyst reviews, refines and, when possible, augments the event solutions generated by the automated processing. The second Spotlight analyst reviews the analyst bulletin from the preceding stage and performs evaluation.

4.2.6.1.3.1 Spotlight Station Processing

Spotlight station processing is the first Spotlight pipeline stage. Spotlight station processing (see Figure 46) runs against spotlight seismic station (SPOT) intervals and treats each seismic station in isolation, making detections, measurements, and beams according to the properties of the detections themselves. In other words, events information based on the network is not yet available at this stage. Spotlight station processing accomplishes all the processing that can be done at the station level.

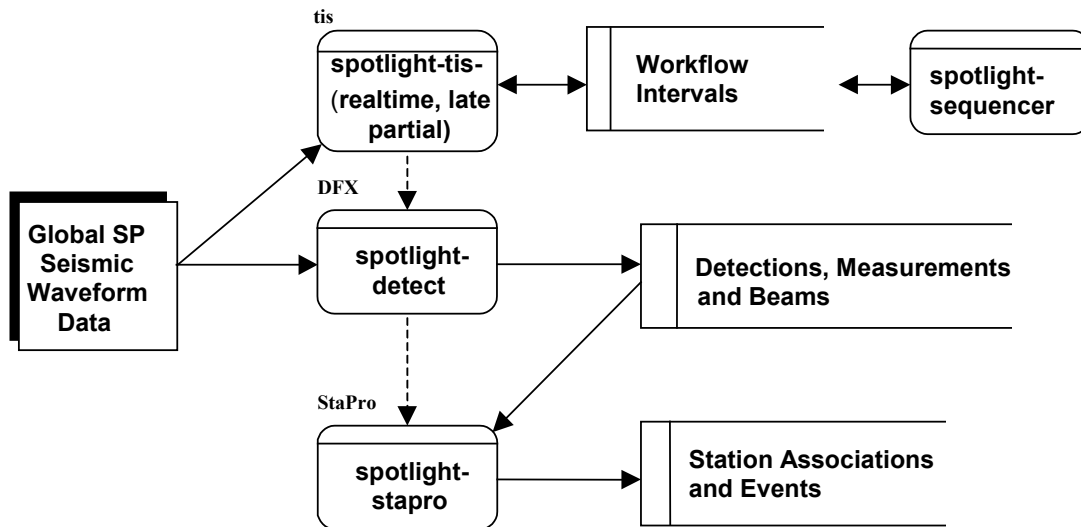


Figure 46. Spotlight Station Processing Data Flow

The *spotlight-tis-realtime* process monitors incoming raw data in a candidate 15-minute time interval for a station. It creates a SPOT interval with a queued state in the global database account and initiates processing on the interval when 100% of the interval is covered by at least one station channel. If a candidate interval does not become 100% filled, but is 16% or more filled, then *spotlight-tis-realtime* creates a partial interval. If the candidate interval does not become at least 16% filled, then *spotlight-tis-realtime* creates a skipped interval.

When approximately 10 minutes have elapsed since a partial interval was created, which gave the Data Acquisition Subsystem a finite amount of time to fill-in the time interval, *spotlight-tis-partial* updates the state of the interval to pending, and *spotlight-tis-realtime* initiates processing on the interval. If a skipped interval becomes at least 16% filled, *spotlight-tis-late* updates the interval state to pending or partial as appropriate, and *spotlight-tis-realtime* initiates interval processing.

The *spotlight-sequencer* process schedules and controls the following sequence of processes to be run on each SPOT that interval marked queued by the *spotlight-tis-realtime* process. As the processing is performed, the *spotlight-sequencer* updates the state of the interval to show the current active process in the sequence. When processing is completed, *spotlight-sequencer* sets the interval state to station-done. If one of the processes fails, then *spotlight-sequencer* attempts to rerun the process. If the process fails a second time, then *spotlight-sequencer* sets the interval state to fail.

The *spotlight-detect* process creates arrival records for valid signals detected on seismic stations. These records contain information such as arrival onset time, SNR, amplitude, and period. It then generates an arrival beam (f-k beam) around each arrival, from the available data, corresponding to the feature measurements made on the arrivals.

The *spotlight-stapro* process groups together arrivals for each station that can reasonably be presumed to have a common origin and, when the necessary seismic phases are available, creates an event (origin) from the association. The grouping is made on the basis of azimuth and slowness for array and three-component sites.

4.2.6.1.3.2 Spotlight Analysis

Spotlight analysis (RAL1) is the second Spotlight pipeline stage. The primary goal in Spotlight analysis (see Figure 47) is to review and refine the event solutions generated by the automated processing system, using all available SP data.

When Spotlight station processing has completed eight 15-minute intervals the analyst can begin to process the 2-hour block covering the intervals. The analyst starts with a read of the data into *ARS*, which creates an *ARS* RAL interval. The analyst reviews the events formed by station processing, and refines arrival and event data as necessary. When the analyst issues the **Save Data** command, the *ARS* saves the remaining unassociated arrivals to the RAL1 account.

The input to Spotlight analysis is the Automated Bulletin in the REGDET database account (accessed through the in_* synonyms in the RAL1 account), and any results that were saved in the RAL1 account during a previous Spotlight analysis session for the same interval or for the adjacent intervals. Information in the RAL1 account regarding a particular event, arrival, etc., takes precedence over the same information found in the REGDET account.

In Spotlight analysis event solutions are obtained by using a multi-stage iterative procedure during which the origins are refined and augmented by the following:

- Locating the event
- Adjusting existing detections (e.g., associate, re-time, rename)
- Adding new arrivals
- Relocating the event to include the additional/modified information
- Verifying that the additional/modified information is consistent with the event

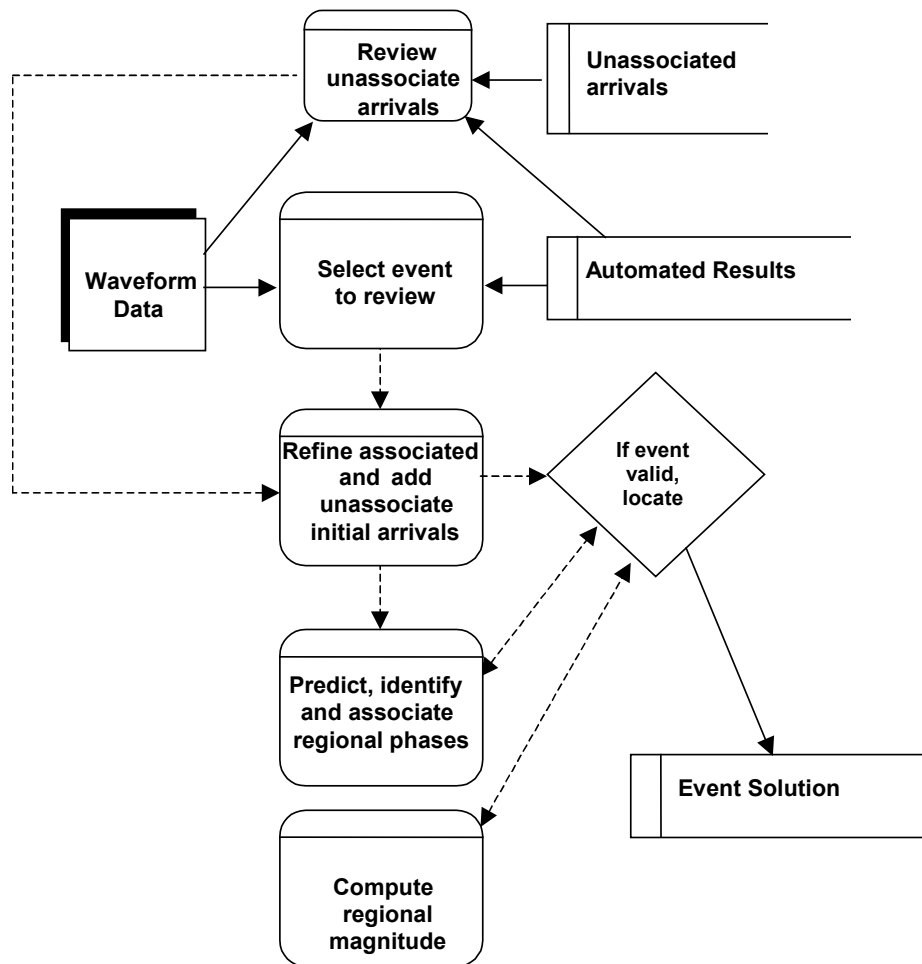


Figure 47. Spotlight Analysis Process Flow

4.2.6.1.3.3 Spotlight Evaluation

Spotlight evaluation (RAL2) is the Spotlight pipeline's last stage. Spotlight evaluation's primary goal is to review and refine the event solutions the Spotlight analyst generates using all available SP data and perform event evaluation for Discrimination purposes. Event evaluation is performed manually without using any Discrimination tools as in the Global pipeline. Therefore, the Spotlight evaluation process flow is similar to the Spotlight analysis previously described except that it uses the spotlight analysis bulletin (RAL) as input.

The analyst starts with a read of the data into the *ARS*, which creates an *ARS* RAL2 interval. The analyst reviews the events formed by the RAL1 analyst, refines arrival and event data as necessary, and performs event evaluation. When the analyst issues the **Save Data** command, the *ARS* saves the remaining unassociated arrivals to the RAL2 account.

The input to Spotlight evaluation is the Analyst Bulletin in the RAL1 database account (accessed through the in * synonyms in the RAL2 account), and any results that were saved in the

RAL2 account during a previous Spotlight evaluation session for the same interval or for the adjacent intervals. Information in the RAL2 account regarding a particular event, arrival, etc., takes precedence over the same information found in the RAL1 account.

In Spotlight evaluation, event solutions are obtained using a multi-stage iterative procedure during which the origins are refined and augmented by the following:

- Adding new arrivals
- Making arrivals defining/non-defining for location/magnitude
- Relocating the event to include the additional/modified information
- Verifying that the additional/modified information is consistent with the event
- Saving the final event solution
- Manually evaluating the event for *Discrimination* purposes

4.2.6.1.3.4 Spotlight Pipeline Event Trace

Figure 48 shows a Spotlight pipeline processing event trace. Table 42 provides an event trace description summary.

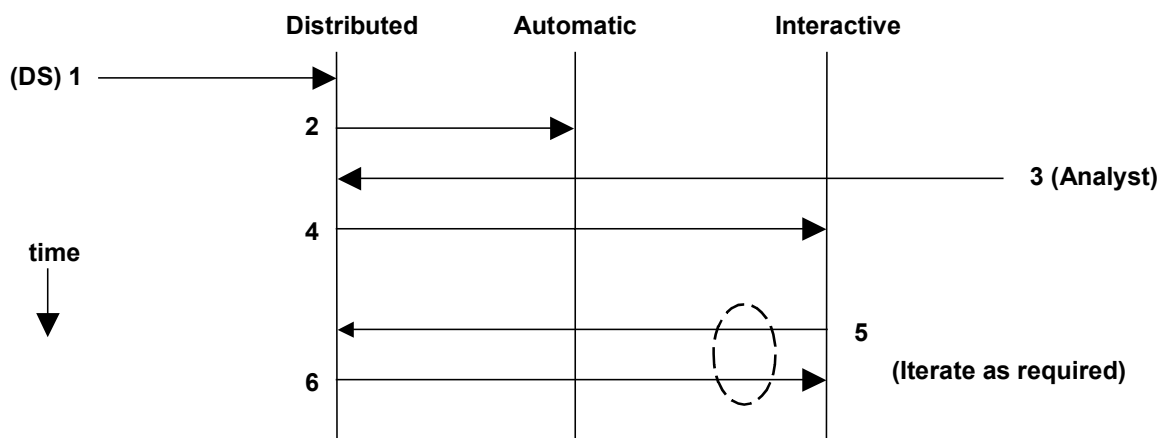


Figure 48. Spotlight Pipeline Event Trace

Table 42. Spotlight Pipeline Event Trace Description

EVENT NO.	CSCI	THREAD	EVENT TRIGGER	EVENT DESCRIPTION	PROCESSING FREQUENCY
1	Distributed	Station processing	Data services acquires sufficient waveform data for station(s) in interval.	DACS data monitor creates interval in interval table for station(s).	Continuous
2	Automatic	Station processing	DACS workflow monitor initiates station processing.	Station processing performed on data in interval and interval table updated.	1/station/15 min
3	Interactive	Analysis	Sufficient completed station processing for analyst interval.	Analyst elects to start analysis after sufficient time elapse.	1/network/120 min
4	Interactive	Analysis	Analyst specifies time interval to analyze.	Analyst performs analysis on interval.	1/network/120 min
5	Interactive	Analysis	Analyst needs interactive processing for interpretation.	Analyst sends command to DACS to perform interactive processing during analysis.	1/process/ analyst session
6	Distributed	Analysis	Message received by DACS to start interactive processing.	DACS starts interactive processing tool(s).	1/process/ analyst session

4.2.6.1.4 Look-Forward Pipeline

The Look-Forward pipeline produces alphanumeric event data from raw waveforms in two stages of automated processing and one stage of interactive processing. The Look-Forward pipeline provides continuous near realtime detection of events in specified target area(s).

Waveform and alphanumeric data are run through station and network processing to detect signals and to form preliminary events, respectively. The resulting automated bulletin is then analyzed. Look-Forward analysis differs from other pipelines in that the trial solutions presented to the analyst do not have locations defined by a set of arrivals, but instead have associations to a set of arrivals that are consistent with an origin in the target region. Look-Forward analysis also differs from the Global pipeline because the automated processing is performed on a subnetwork of stations. The primary goal for the Look-Forward analyst is to determine whether or not the associated detections provided by the automated system define an event that falls within the target AOI and, therefore, warrants further attention. If the event is validated, the analyst uses stations from the entire global network to refine the solution.

4.2.6.1.4.1 Look-Forward Station Processing

Look-Forward station processing is the first Look-Forward pipeline stage. Look-Forward station processing (see Figure 49) runs against Look-Forward seismic station (LFSEIS) intervals and treats each seismic station in isolation, making detections, measurements, and beams according to the detections' properties themselves. In other words, events information based on the network is not yet available at this stage. Look-Forward station processing accomplishes all the processing that can be done at the station level.

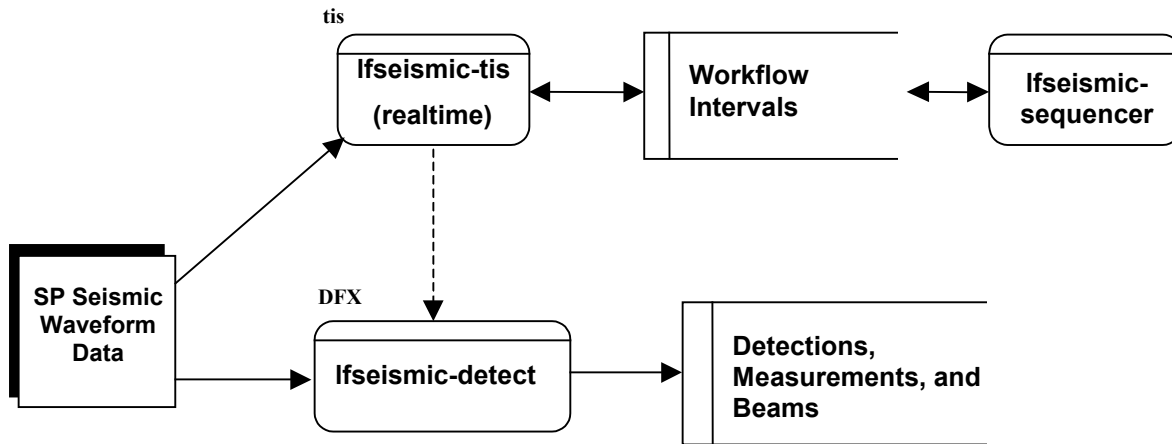


Figure 49. Look-Forward Station Processing Data Flow

The *lfseismic-tis-realtime* process monitors the incoming raw data in a candidate 5-minute time interval for a station. It creates an LFSEIS interval with a queued state in the global database account and initiates processing on the interval when 80% of the interval is covered by at least one station channel. If the candidate interval does not become 80% filled, then *lfseismic-tis-realtime* creates a skipped interval.

The *lfseismic-detect* process creates arrival records for valid signals detected on one of a set of predefined detection beams for the station. It then attempts to generate 5-minute arrival beams (f-k beams) around each arrival to correspond to the feature measurements made on the arrivals. When there is less than 5-minutes of waveform data to generate a 5-minute beam, it is left to the Look-Forward pipeline's network processing stage to generate shorter duration arrival beams using available waveform data. For ASN stations, detection processing runs against the BB and SP waveform data for the station.

4.2.6.1.4.2 Look-Forward Network Processing

Look-Forward network processing is the Look-Forward pipeline's second stage. Look-Forward network processing (see Figure 50) occurs every 5 minutes, and runs against the data set whose endtime is given by the current new Look-Forward network (LFNET) interval. The processing

assembles the detection data from the available stations to associate them into preliminary events based on multiple stations.

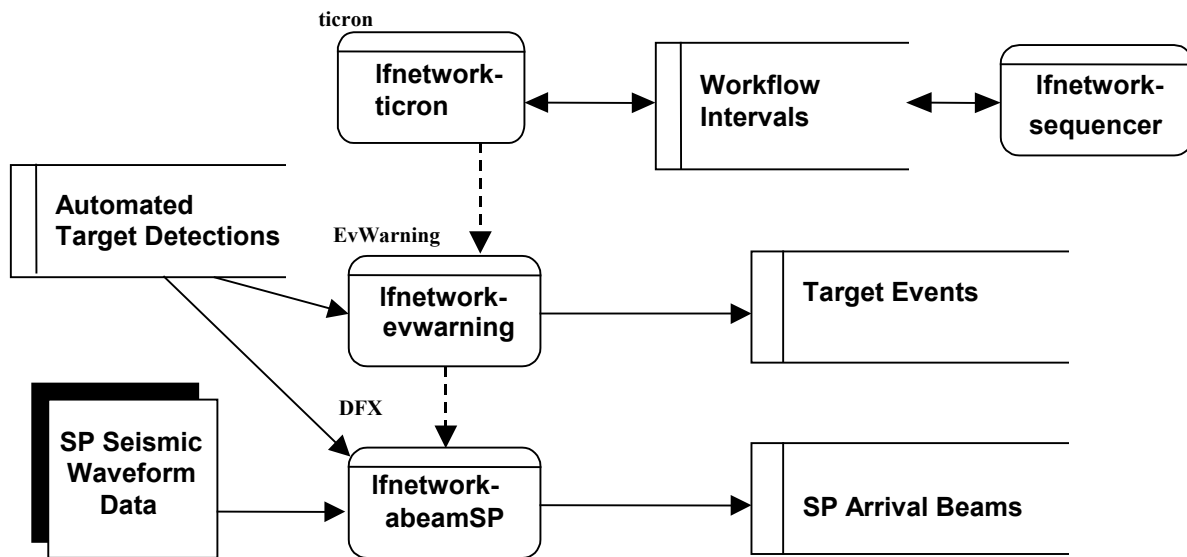


Figure 50. Look-Forward Network Processing Data Flow

The *lfnetwork-ticron* process continuously creates LFNET intervals with a queued state in the global database account and initiates processing on the intervals. No criteria are used when creating the intervals.

The *lfnetwork-sequencer* process schedules and controls the following sequence of processes to be run on each LFNET interval marked queued by the *lfnetwork-ticron* process. As the processing is performed, the *lfnetwork-sequencer* updates the state of the interval to show the current active process in the sequence. When processing is completed, *lfnetwork-sequencer* sets the state of the interval to network-done. If one of the processes fails, *lfnetwork-sequencer* attempts to rerun the process. If the process fails a second time then *lfnetwork-sequencer* sets the interval state to fail.

The *lfnetwork-evwarning* process finds arrival associations by comparing new arrivals with predefined information for theoretical arrivals from the target. Origins are created when the number of associated arrivals exceeds the minimum number of associated arrivals defined for the target. Electronic mail, known as e-mail, and an audible alarm is sent to the OPS users specified in the file `/home/ops/.forward` when such an event is evident, and accelerated analysis may be performed.

The *lfnetwork-abeamSP* process creates arrival beams for arrivals that do not already have 5-minute-long beams as configured in station processing. When constrained by the length of available waveform data, the *lfnetwork-abeamSP* process relaxes the time requirement and

creates shorter duration arrival beams. Forming some of the arrival beams during network processing allows the data acquisition additional time to receive all available data and increases the probability of consistently creating 5-minute-long arrival beams.

4.2.6.1.4.3 Look-Forward Analysis

Look-Forward analysis is the final Look-Forward pipeline stage. Look-Forward analysis' primary goal (see Figure 51) is to determine if the associated arrivals provided by the automated processing system define an event deemed valid by an analyst and if such an event warrants further consideration and analysis due to its proximity to a target area.

The analyst starts with a read of the data into the *ARS*, which creates an *ARS* FAL interval. The analyst reviews the events formed by network processing, and refines arrival and event data as necessary. When the analyst issues the **Save Data** command, the *ARS* saves the remaining unassociated arrivals to the FAL account.

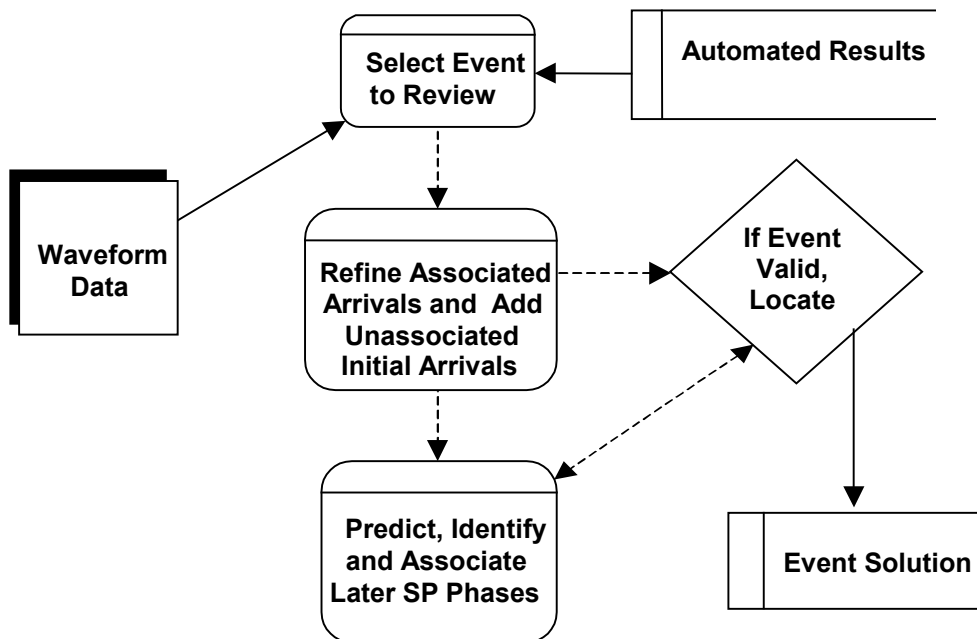


Figure 51. Look-Forward Analysis Process Flow

The input to Look-Forward analysis is the Automated Bulletin in the LFDET database account (accessed through the in_* synonyms in the FAL account) and any results that were saved in the FAL account during a previous Look-Forward analysis session for the same interval or for the adjacent intervals. Information in the FAL account regarding a particular event, arrival, etc., takes precedence over the same information found in the LFDET account.

In Look-Forward analysis, event solutions are obtained using a multi-stage iterative procedure during which the origins are refined and augmented by the following:

- Locating the event (the automated system provides a solution with the target as the origin epicenter, and associated arrivals that are consistent with an event at the target)
- Adjusting existing detections (e.g., associate, re-time, rename, etc.)
- Adding new arrivals
- Relocating the event to include the additional/modified information
- Verifying that the additional/modified information is consistent with the event

4.2.6.1.4.4 Look-Forward Pipeline Event Trace

Figure 52 shows a Look-forward pipeline processing event trace. Table 43 provides an events trace description summary.

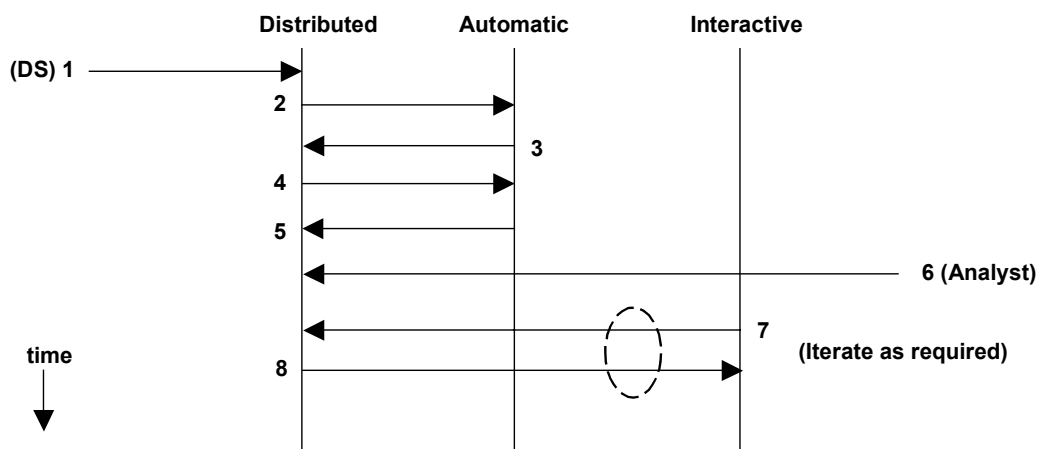


Figure 52. Look-Forward Pipeline Event Trace

Table 43. Look-Forward Pipeline Event Trace Description

EVENT NO.	CSCI	THREAD	EVENT TRIGGER	EVENT DESCRIPTION	PROCESSING FREQUENCY
1	Distributed	Station processing	Data services acquires sufficient waveform data for station(s) in interval.	DACS data monitor creates interval in interval table for station(s).	Continuous
2	Automatic	Station processing	DACS workflow monitor initiates station processing.	Station processing performed on data in interval and interval table updated.	1/station/5 min

Table 43. Look-Forward Pipeline Event Trace Description (Continued)

EVENT NO.	CSCI	THREAD	EVENT TRIGGER	EVENT DESCRIPTION	PROCESSING FREQUENCY
3	Distributed	Network processing	Sufficient completed station processing for network interval.	DACS data monitor creates interval in interval table for network.	Continuous
4	Automatic	Network processing	DACS workflow monitor initiates network processing.	Network processing performed on data in interval and interval table updated.	1/network/5 min
5	Distributed	Alert	DACS workflow monitor checks if event(s) were formed.	Alarm sounded and email sent to alert SOM/analyst.	1/event/5 min
6	Interactive	Analysis	Analyst specifies time interval to analyze.	Analyst performs analysis on interval.	1/alert
7	Interactive	Analysis	Analyst needs interactive processing for interpretation.	Analyst sends command to DACS to perform interactive processing during analysis.	1/process/ analyst session
8	Distributed	Analysis	Message received by DACS to start interactive processing.	DACS starts interactive processing tool(s).	1/process/ analyst session

4.2.6.1.5 Hydroacoustic Pipeline

The Hydroacoustic pipeline transforms raw waveforms into alphanumeric event data in one stage of automated processing and one stage of interactive processing.

4.2.6.1.5.1 Hydroacoustic Station Processing

Hydroacoustic station processing is the Hydroacoustic pipeline's first stage. Hydroacoustic station processing (see Figure 53) runs against hydroacoustic station (HYDR) intervals and treats each station in isolation, making detections and measurements. Hydroacoustic station processing accomplishes all the processing that can be done at the station level.

The *hydro-detect* process creates arrival records for valid signals detected on the station, using a high SNR threshold. There is no beamforming with hydroacoustic processing.

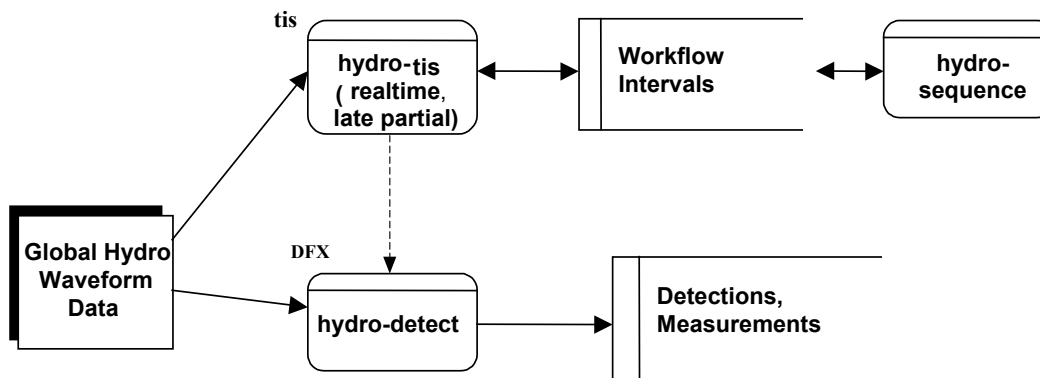


Figure 53. Hydroacoustic Station Processing Data Flow

4.2.6.1.5.2 Hydroacoustic Analysis

Hydroacoustic analysis uses as inputs arrivals produced by the automated processing. The automated system does not attempt to associate phases (across the Hydroacoustic Network) and define origin hypotheses. Hydroacoustic analysis (see Figure 54) is performed to review the detections from automated processing, refine the feature measurements for valid signals, modify their phase identification as required, and add signals missed by the automated processing.

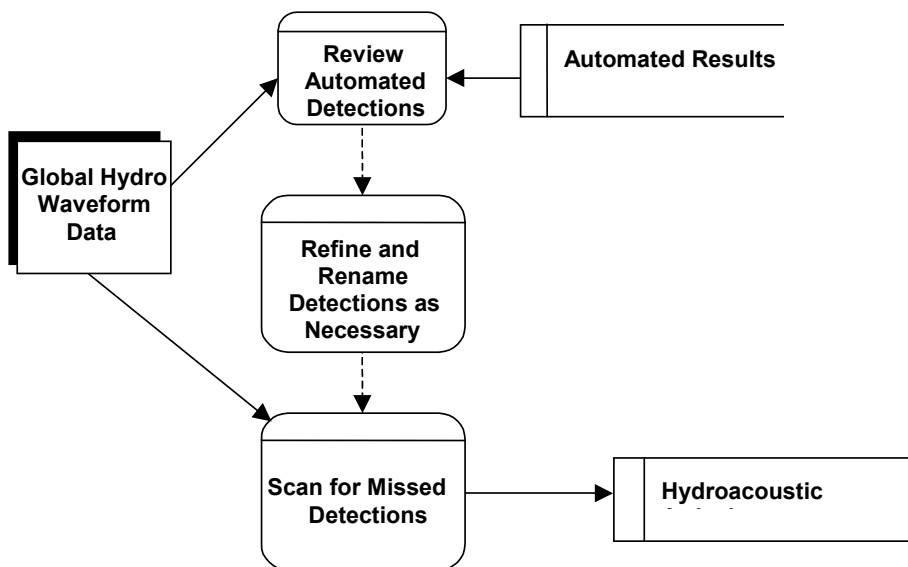


Figure 54. Hydroacoustic Analysis Process Flow

The input to Hydroacoustic analysis is the Automated Bulletin in the HYDRODET database account (accessed through the in_* synonyms in the HAL account) and any results that were

saved in the HAL account during a previous Hydroacoustic analysis session for the same interval or for the adjacent intervals. Information in the HAL account regarding a particular event, arrival, etc., takes precedence over the same information found in the HYDRODET account.

4.2.6.1.5.3 Hydroacoustic Pipeline Event Trace

Figure 55 shows a Hydroacoustic pipeline processing event trace. Table 44 provides an event trace description summary.

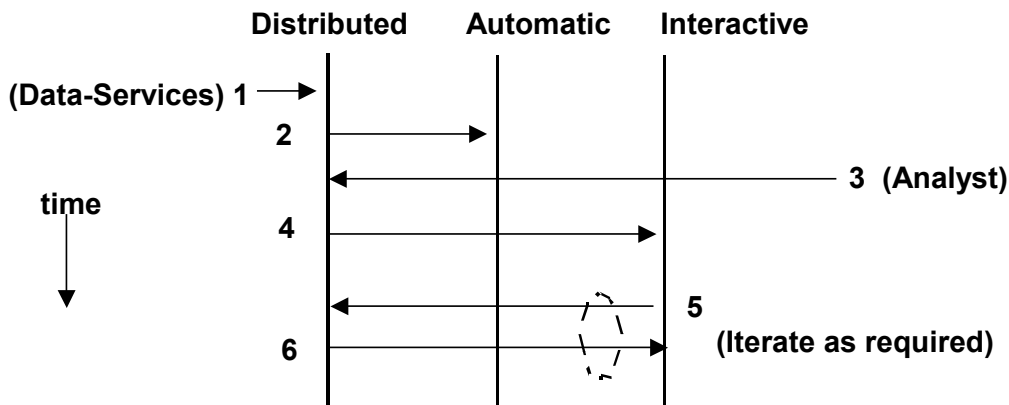


Figure 55. Hydroacoustic Pipeline Event Trace

Table 44. Hydroacoustic Pipeline Event Trace Description

EVENT NO.	CSCI	THREAD	EVENT TRIGGER	EVENT DESCRIPTION	PROCESSING FREQUENCY
1	Distributed	Station Processing	Data services acquires sufficient waveform data for station(s) in interval.	DACS data monitor creates interval in interval table for station(s).	Continuous
2	Automatic	Station Processing	DACS workflow monitor initiates station processing.	Station processing performed on data in interval and interval table updated.	1/station/15 min
3	Interactive	Analysis	DACS workflow interface shows sufficient completed station processing for analyst interval	Analyst directed to start analysis.	1/network/120 min

Table 44. Hydroacoustic Pipeline Event Trace Description (Continued)

EVENT NO.	CSCI	THREAD	EVENT TRIGGER	EVENT DESCRIPTION	PROCESSING FREQUENCY
4	Interactive	Analysis	Analyst specifies time interval to analyze.	Analyst performs analysis on interval.	1/analyst request
5	Interactive	Analysis	Analyst needs interactive processing for interpretation.	Analyst sends command to DACS to perform interactive processing during analysis.	1/process/ analyst session
6	Distributed	Analysis	Message received by DACS to start interactive processing.	DACS starts interactive processing tool(s).	1/process/ analyst session

4.2.6.2 Classified Performance Monitoring

The Performance Monitoring component provides the capability to evaluate US NDC System performance. It monitors data processing attributes, which encompass the performance of the system. Attribute performance summaries are presented in a graphical manner. The component runs semi-automatically in routine operational mode and interactively when used as an investigatory tool.

4.2.7 Mission Transfer Support Subsystem

4.2.7.1 United States National Data Center Data Replication to the Alternate United States National Data Center

To support the mission, data available at the US NDC is replicated to the Alt US NDC. The types of data replicated are continuous alphanumeric, continuous waveform, and backfill waveform.

4.2.7.1.1 Continuous Alphanumeric Data

Data replication begins, in part, by enabling continuous Oracle Replication Server processing to occur across the WAN from the US NDC, for both the Operational and Archive databases. This processing updates the Alt US NDC database with all transactions that have occurred at the US NDC since the last time Oracle Replication Server processing occurred. The step is important because at mission transfer time the waveform data processing pipelines continues at the Alt US NDC from exactly where they left off at the US NDC to permit final completion of mission performance against the waveform data and for general data archiving purposes. When Oracle Replication Server processing reaches the point where it is handling only newly occurring transactions, the Alt US NDC is minimally ready to support the mission. Other tasks such as the

backfilling of waveform data have not yet occurred, as described in the next section, but are not considered critical to prevent a mission transfer.

4.2.7.1.2 Continuous Waveform Data

Once Oracle Replication Server processing is caught up, the second part of data replication to the Alt US NDC begins by enabling continuous waveform data forwarding to occur across the WAN from the US NDC. This functionality handles both unprocessed and processed waveform data, consisting of framestores and beams respectively. Framestore forwarding is performed by *FrameEx* process instances which are initiated to begin transmitting the CD-1.1 frames for the current 2-hour time interval from the US NDC framestore to the Alt US NDC. By beginning with the current framestore file and ignoring the older framestore files, *FrameEx* soon reaches the point where it is handling only newly acquired frames. Figure 56 shows this real-time data flow as a right to left horizontal arrow. Beam forwarding is performed by the process *BeamRep*, which like *FrameEx* is initiated to begin transmitting beams for the current 2-hour time interval to the Alt US NDC and soon reaches the point where it is handling only newly formed beams. *FrameEx* and *BeamRep* both run simultaneously with Oracle Replication Server processing. Figure 57 shows the real-time data flow of beam files as the arrow labeled continuous forwarding.

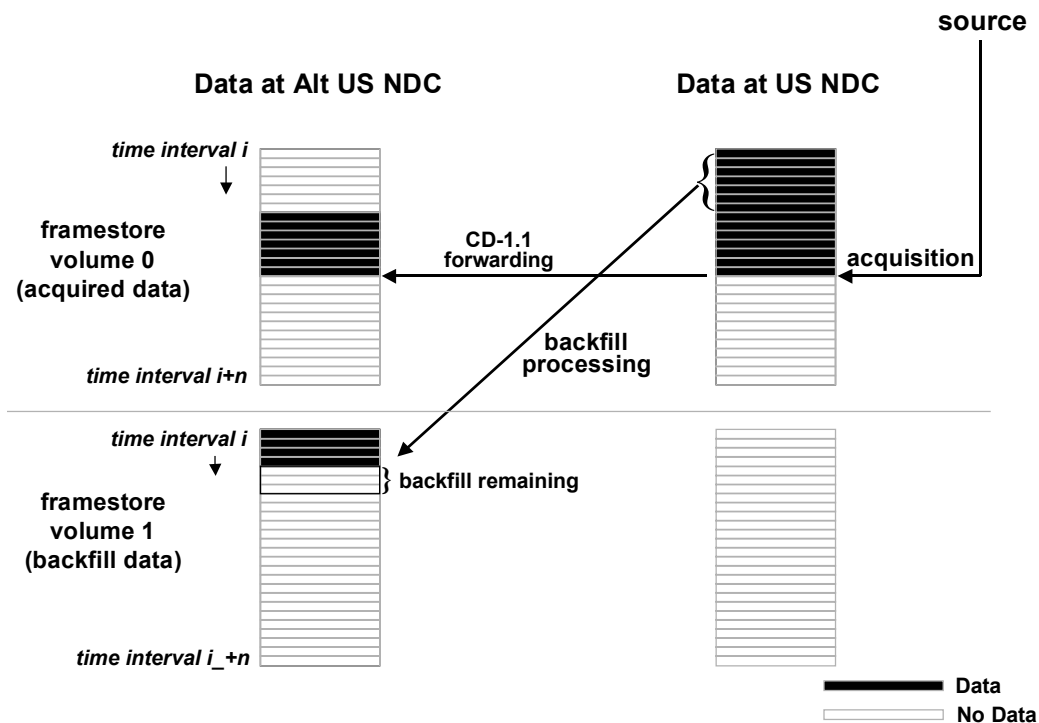


Figure 56. Continuous Waveform Data Flow after Start of Wide Area Network Communications

4.2.7.1.3 Backfill Waveform Data

All waveform data from older time intervals is provided to the Alt US NDC by the *BackfillExport* process and inserted into the Alt US NDC System by the combination of *BackfillImport* and *BackfillInsert*. These processes handle the backfilling of both archived and unarchived waveform data, including framestores and beams, and are driven by *WorkFlow* intervals created by the system operator. Figure 57 shows the data flow for the backfill of framestore files from the US NDC as a right to left diagonal arrow, and shows its relationship to the real-time data-flow which runs simultaneously. *BackfillExport* has functionality to permit writing the data to a DLT tape instead of to the remote filesystem directly. When used in this way, its counterpart *BackfillImport* reads the data from tape and load it into the filesystem, thereby bypassing the WAN. *BackfillInsert* provides the functionality to place the data into the proper filesystem and corresponding records into the database in the Operational or Archive Systems at the local site, depending on the type of data imported. Figure 57 shows the data flow for the backfill of beam files from the US NDC as the arrow labeled backfill processing, and shows its relationship to the real-time data-flow, which runs simultaneously.

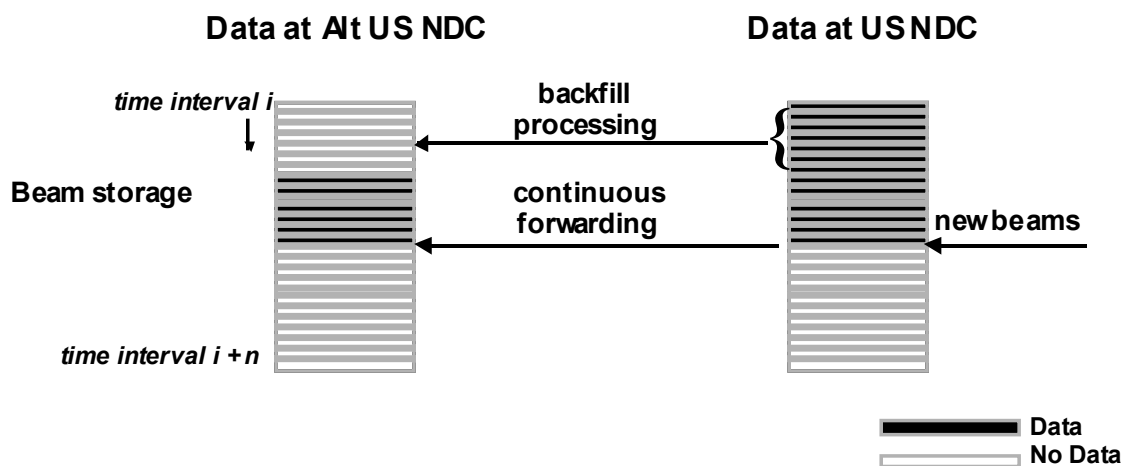


Figure 57. Processed Waveform Data flow after Start of Wide Area Network Communications

4.2.7.2 Mission Transfer to the Alternate United States National Data Center

The mission transfer process consists of transferring data acquisition and processing functions from the US NDC to the Alt US NDC. The process begins at the US NDC and consists of stopping the data processing activity on the system and, after a few minutes, stopping the Oracle Replication Server processing. The process' second part of this occurs outside the US NDC and consists of starting the ADSN and US NDC functionality, including the database, at the Alt US NDC and switching the CACI circuits so that waveform data is provided to the Alt US NDC instead of the US NDC. When this switch occurs, ADSN functionality at AFTAC

becomes idle and remains so until the mission is returned to the US NDC. Figure 58 shows the state of waveform data acquisition at the Alt US NDC immediately after mission transfer. From where it left off at the US NDC, data processing continues as new waveform data is acquired by the Alt US NDC. If the mission transfer is initiated by an unplanned failure at the US NDC, the first part of this process is skipped; no problems should arise because of it.

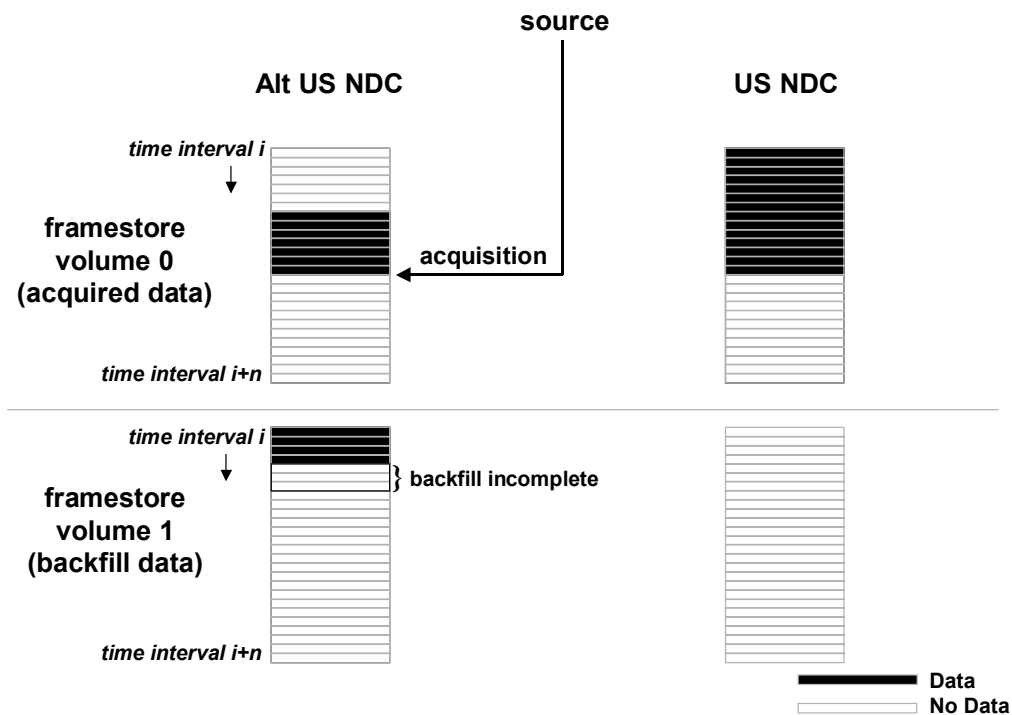


Figure 58. Unprocessed Waveform Data Flow after Mission Transfer to Alternate United States National Data Center

4.2.7.3 Mission Return to the United States National Data Center

Return of mission begins once the original mission transfer cause (e.g., hurricane) has passed and the following facilities are available at the US NDC (in order):

1. Reliable commercial and backup electric power
2. Air conditioning and other building facilities
3. Networking critical to the US NDC at PAFB
4. US NDC equipment is powered-up (includes ADSN equipment)
5. Networking between PAFB and GAFB

4.2.7.3.1 Continuous Alphanumeric Data

Preparation for mission return to the US NDC begins by enabling Oracle Replication Server processing to occur for both the Operational and Archive databases across the WAN from the Alt US NDC. This processing updates the US NDC database with all transactions that occurred at the Alt US NDC since the last time Oracle Replication Server processing occurred. This step is important because at mission return time the waveform data processing pipelines resume at the US NDC exactly where they left off at the Alt US NDC in order to permit final completion of mission performance against the waveform data and for general data archiving purposes.

Oracle replication server processing occurs while data acquisition, processing, and archiving is ongoing, without any impact to the normal data flow through the system as it supports the mission. Depending on the nature and duration of the outage at the US NDC, the replication processing may take up to several hours before it reaches steady state condition. In steady state condition, all the older data processing results have been successfully transferred to the US NDC and the replication data stream is composed entirely of new data processing results from the active data processing pipeline at the Alt US NDC.

4.2.7.3.2 Continuous Waveform Data

When Oracle Replication Server processing reaches the point where it is handling only newly occurring transactions, the first step in the mission return process is complete and the US NDC is ready to again support the mission. The second step in the mission return process is to provide continuous waveform data to the US NDC. This occurs by enabling the ADSN and US NDC functionality at PAFB and by switching the CACI circuits so that waveform data is provided to the US NDC instead of to the Alt US NDC. When this switch occurs, the ADSN functionality at GAFB becomes idle and remains so until the next time the mission must transfer to the Alt US NDC. This switch of continuous waveform data can occur while active and interactive pipeline processing are processing the available waveform data at the Alt US NDC. Figure 58 shows the resumed real-time data-flow as a right to left horizontal arrow.

4.2.7.3.3 Backfill Waveform Data

The process of backfilling the waveform data from the Alt US NDC to the US NDC is the same process described in Section 4.2.7.1.3, except the data is flowing in the opposite direction. Figure 59 shows the data-flow for the backfill of framestore files from the Alt US NDC as a left to right diagonal arrow, and shows its relationship to the real-time data flow which runs simultaneously. Figure 60 shows the relationship between the *WorkFlow* intervals defined by the operator and the archive and framestore storage that is backfilled by the *BackfillExport* and *BackfillImport* processing that is run against the intervals.

When the mission transfer to the Alt US NDC was an unplanned transfer, there is likely some backfilling needed to finally complete the dataset at the Alt US NDC. This back filling from the US NDC to the Alt US NDC can occur during or after the backfilling occurring as part of the mission return process. In either case, the process for this is defined in Section 4.2.7.1.3.

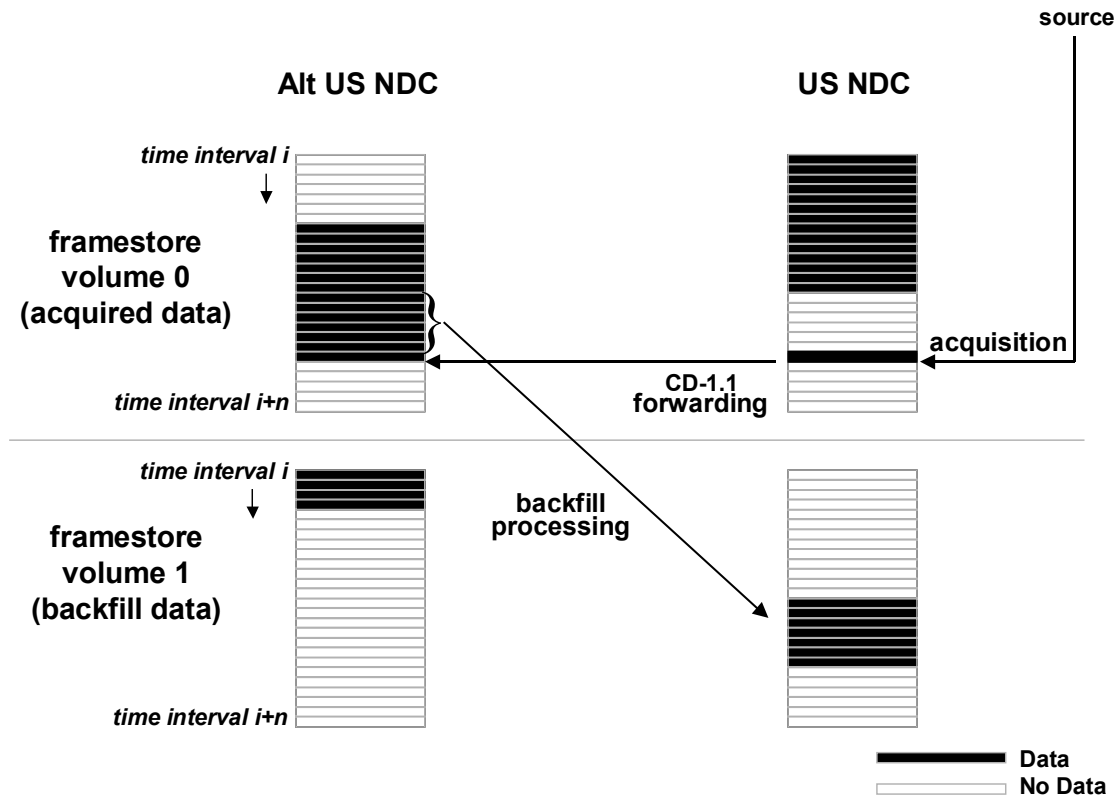


Figure 59. Unprocessed Waveform Data Flow after Mission Return to United States National Data Center

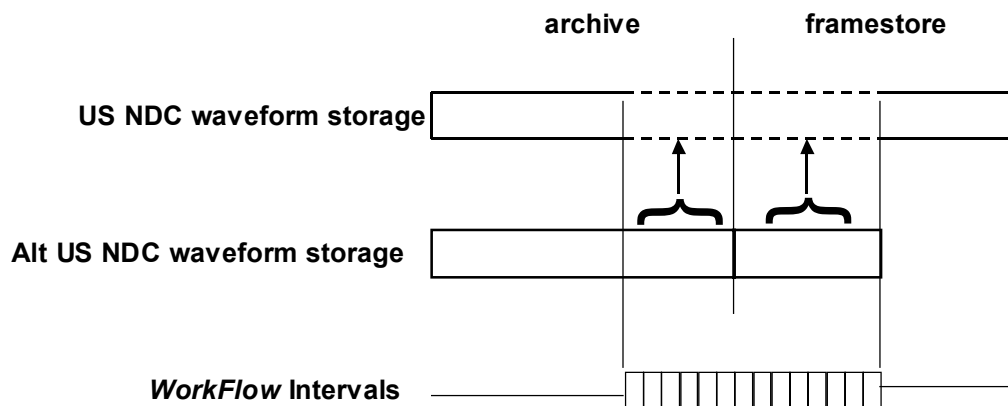


Figure 60. WorkFlow Interval-based Backfill Processing

4.2.8 Training System Execution

4.2.8.1 Purpose

The US NDC Training System provides analyst training to AFTAC personnel on the US NDC Operational System. It resides at GAFB as a replacement for the existing ADSN Subsurface Analyst Training Network (SATN). All US NDC interactive analysis software functions are available on the Training System for use as needed in the training program. These functions include beamforming, analysis, and bulletin preparation.

4.2.8.2 Database Accounts

The Oracle database contains a set of automated processing accounts configured like those found on the US NDC Operational System. The database also contains interactive processing accounts for students, covering the first stage of analysis in each pipeline found on the US NDC Operational System. This provides each student a set of accounts, each named to correspond with the name of a US NDC Operational System pipeline. The instructor maintains all accounts, which includes inserting and deleting data from all accounts, and removing and recreating the student accounts.

4.2.8.3 Student Workstations

The Student Workstations provide the interactive analysis environment needed for training on the US NDC analysis functions. Beyond this, the Student Workstations are connected to the Instructor Workstation with the SmartClass 2000 Computer Classroom Control System, a COTS software training package that provides training functions such as the capability to display Instructor Workstation activities on Student Workstations and Student Workstation activities on the Instructor Workstation.

4.2.8.4 Instructor Workstation

The Instructor Workstation contains functionality beyond that of the Student Workstations. From this workstation the instructor has access to all analysis and maintenance activities. These activities include student account management, process control, and data preparation. A Launch and WorkFlow applications configuration provides the user interfaces needed for these activities. The Instructor Workstation work area also contains the control panel for the SmartClass 2000 Control System for access during training.

4.2.8.5 Data Preparation

4.2.8.5.1 Loading Data Sets

DLT media and the UNIX tar command load waveform and alphanumeric data from the US NDC Classified System onto the Training System. The waveform data is copied to tape in CSS 3.0 format, while the alphanumeric data from all automated processing accounts is copied to

tape in the Oracle export format. When extracting the data from tape, data checksums verify the copy's integrity. Data sets extracted from tape can be selectively loaded individually into the database as needed for training.

With the exception of **wfdisc** records, alphanumeric data loaded on the Training System is not modified for any reason during the loading process. The **wfdisc** records, however, are modified to account for differences in the locations of waveform files on the US NDC Operational System and the Training System and to account for **wfdisc** identifier (*wfid*) rollover, which occurs each time that the operational system reaches 100 million **wfdisc** records.

4.2.8.5.2 Beam Generation

Through the use of automated processing, the US NDC Operational System automatically generates detection and origin beams. Since raw data can be received on the US NDC Operational System after analysis is performed on the available data, there is a potential for beams to be missing from the imported data sets. The Training System provides the capability to generate detection and origin beams from the available raw data. The Instructor Workstation manually initiates this process on the Training System.

4.2.8.5.3 Student Account Preparation

To prepare for the next training course, analysis results left over from the last training course conducted on the Training System must be removed from the student accounts. The student account is removed and recreated, which deletes all data it contained. The Instructor Workstation's launch interface provides this functionality.

4.2.8.6 Storage Capacity

The Training System provides storage capacity for 15 days of waveform and alphanumeric data generated by the US NDC and the storage capacity to store the alphanumeric data generated by students and the instructor during training. The US NDC receives and stores an estimated 17 GB of waveform data per day. US NDC pipeline processes generates an additional 0.074 GB of alphanumeric data per day. The students generate an estimated 2 GB of alphanumeric data during training class. This implies that the Training System must have the storage capacity for $((17 + 0.074) * 15) + 2 = 258$ GB data. The server's RAID 5 configuration provides 280 GB of formatted storage.

4.2.8.7 Backup Capability

To minimize the possibility of loss or corruption of data, an automated backup capability is provided. A CRON job runs daily to do hot Oracle table spaces and online transaction logs backups. The CRON job backs up the files into backup directories on disk. Solstice Backup, which is included with the standard Solaris Server OS, performs daily Oracle backup disk directories (and other files) backup to DLT. The tapes are kept offline and used to restore data as necessary. Solstice Backup includes a GUI which allows easy restoration of selected files (or a complete system restore, if needed).

4.2.8.8 Operational Scenario

4.2.8.8.1 Data Export

Based on the total amount of data needed and of the processing results' characteristics in the data sets, the Training Instructor must first decide which data set(s) are needed for training. Each data set is described entirely by the time interval covered by the data set since all available waveform data and the alphanumerics from all of the automated processing accounts are to be included in the data set. The utility TrainingExport is run on the US NDC Classified Archive Subsystem, against the list of data set(s) desired, to obtain this data and place it on tape. The tape is then transferred to the Training System location with handling appropriate for classified data.

4.2.8.8.2 Data Import

Upon receipt of the tape of data extracted from the US NDC Archive, the US NDC Training System Instructor Workstation runs the TrainingImport utility, to place the data into a file system and add intervals to the WorkFlow interface for each data set. The instructor individually loads each data set into the database by selecting the load function from the appropriate WorkFlow interval's popup menu. Once the load has completed, the detection and origin beams for each data set are created by selecting the generate beams function from the appropriate WorkFlow interval's popup menu. Figure 61 shows the data flow in the transfer of data from the US NDC Classified Archive Subsystem to the US NDC Training System.

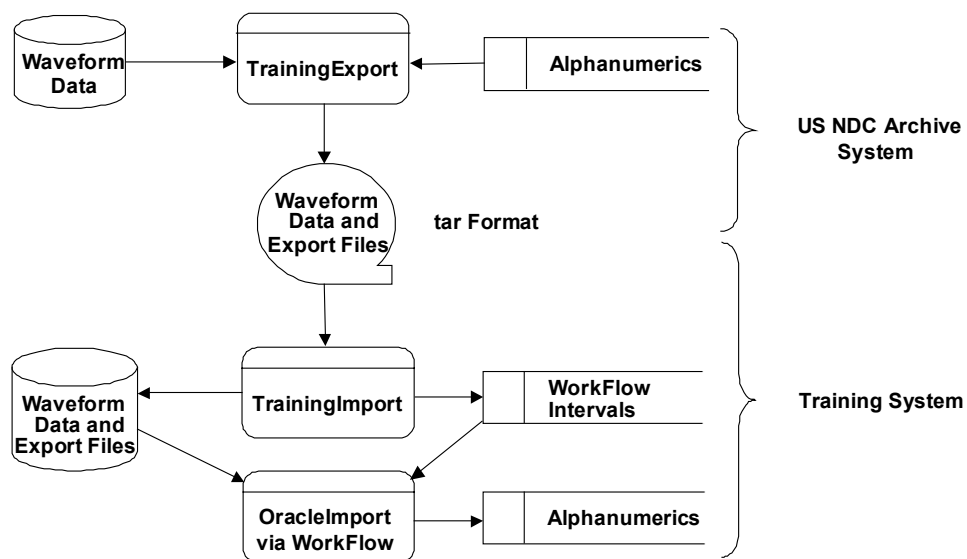


Figure 61. United States National Data Center to Training System Data Flow

4.3 Interface Design

4.3.1 External Interfaces

SAIC-00/3042, Interface Control Document (ICD) for United States National Data Center (US NDC) Phase 2, defines the system's external interfaces.

4.3.2 Internal Interfaces

4.3.2.1 Mapping Software and Hardware to Subsystems

Table 45 lists the HWCIs and CSCIs each subsystem uses to fulfill its functions.

**Table 45. Internal Interface Hardware Configuration Item/
Software Configuration Item Allocation**

SUBSYSTEM	HWC(S)	CSCI(S)
Unclassified Data Acquisition Subsystem	Unclassified Data Acquisition Network Infrastructure	Distributed Data-Services Data-Management
Unclassified Archive Subsystem	Unclassified Archive Network Infrastructure	Distributed Data-Services Data-Management
Classified Data Acquisition Subsystem	Classified Analysis Network Infrastructure	Distributed Data-Services Data-Management
Classified Analysis Subsystem	Classified Analysis Analyst/Evaluator Network Infrastructure	Distributed Data-Management Automatic Interactive Monitoring Tuning
Classified Archive Subsystem	Classified Archive Network Infrastructure	Distributed Data-Services Data-Management

4.3.2.2 UDAS_UARCS

4.3.2.2.1 Waveform Data

4.3.2.2.1.1 Data Description

The Unclassified Data Acquisition Subsystem transfers waveform data to the Unclassified Archive Subsystem for long-term storage of data. The transferred waveform data consists of

waveform data files (.w files) and waveform data descriptive records (**wfdisc**) as defined in the DBDD. The waveform data files contain the actual time-series data samples.

4.3.2.2.1.2 Data Transmission

TCP/IP network communications transfer data from the Unclassified Data Acquisition Subsystem to the Unclassified Archive Subsystem. A Unclassified Data Acquisition Subsystem File System NFS mount also makes data available.

4.3.2.2.1.3 Logical Interface

The Data-Services and Data-Management CSCIs provide the logical interface for waveform data transfer of from the Unclassified Data Acquisition Subsystem to the Unclassified Archive Subsystem. Oracle SQL transactions update and maintain the appropriate database tables.

4.3.2.2.1.4 Physical Interface

The Network Infrastructure HWCI provides physical interface between the Unclassified Data Acquisition Subsystem and the Unclassified Archive Subsystem, which then provides interface between the Unclassified Data Acquisition HWCI and the Unclassified Archive HWCI. Table 39 provides the HWCI/CSCI allocation.

4.3.2.3 UDAS_CDAS

4.3.2.3.1 Waveform Data

4.3.2.3.1.1 Data Description

Unclassified Data Acquisition Subsystem framestore CD-1.1 protocol frames are combined together into files and transferred to the Classified Data Acquisition Subsystem, where they are stored into the classified framestore for processing.

4.3.2.3.1.2 Data Transmission

The TGS secure hardware NFS protocol transfers CD-1.1 protocol waveform data files from the Unclassified Data Acquisition Subsystem to the Classified Data Acquisition Subsystem, through.

4.3.2.3.1.3 Logical Interface

The Data-Services and Data-Management CSCIs provide the logical interface for waveform data transfer from the Unclassified Data Acquisition Subsystem to the Classified Data Acquisition Subsystem. The Unclassified Data Acquisition Subsystem *FStoFile* process transfers the data to the Classified Data Acquisition Subsystem *FiletoFS* process through the TGS secure hardware. Figure 21 shows this process.

4.3.2.3.1.4 Physical Interface

The Network Infrastructure HWCI TGS is the physical interface for waveform data transfer between the Unclassified Data Acquisition Subsystem and the Classified Data Acquisition Subsystem; it also provides the interface between the Unclassified Data Acquisition HWCI and the Classified Analysis HWCI. The TGS guarantees either complete and accurate delivery or no delivery at all. Table 45 provides HWCI/CSCI allocation.

4.3.2.3.2 Interval Data

4.3.2.3.2.1 Data Description

The Unclassified Data Acquisition Subsystem **interval** table's interval data is written to files and transferred to the Classified Data Acquisition Subsystem where it is stored into the classified side **interval** table for display in the Classified Data Acquisition Workflow GUI and for use in processing and analysis. The interval data, which the DBDD defines in detail, is transferred every 60 seconds to the Classified Data Acquisition Subsystem.

4.3.2.3.2.2 Data Transmission

The TGS secure hardware uses NFS protocol to transfer interval data files from the Unclassified Data Acquisition Subsystem to the Classified Data Acquisition Subsystem.

4.3.2.3.2.3 Logical Interface

The Data-Services and the Data-Management CSCIs provide the logical interface for interval data files transfer from the Unclassified Data Acquisition Subsystem to the Classified Data Acquisition Subsystem. The Unclassified Data Acquisition Subsystem *send_interval* process transfers the interval data to the Classified Data Acquisition Subsystem *recv_interval* process through the TGS secure hardware.

4.3.2.3.2.4 Physical Interface

The Network Infrastructure HWCI TGS provides the physical interface for interval data files transfer between the Unclassified Data Acquisition Subsystem and the Classified Data Acquisition Subsystem and the interface between the Unclassified Data Acquisition and Classified Analysis HWCI. The TGS guarantees either complete and accurate deliver or no delivery at all. Table 45 provides HWCI/CSCI allocation.

4.3.2.3.3 Invoice Data

4.3.2.3.3.1 Data Description

To detect missing data on the Classified Data Acquisition Subsystem, the Unclassified Data Acquisition Subsystem transfers an invoice file to the Classified Data Acquisition Subsystem

which reports on the CD-1.1 frame data that has been transferred from the Unclassified Data Acquisition Subsystem to the Classified Data Acquisition Subsystem.

4.3.2.3.3.2 Data Transmission

The TGS secure hardware uses NFS protocol to transfer invoice data files from the Unclassified Data Acquisition Subsystem to the Classified Data Acquisition Subsystem.

4.3.2.3.3.3 Logical Interface

The Data-Services and Data-Management CSCIs provide the logical interface for invoice data files transfer from the Unclassified Data Acquisition Subsystem to the Classified Data Acquisition Subsystem. The Unclassified Data Acquisition Subsystem *FStoFile* process transfers the invoice data to the Classified Data Acquisition Subsystem *FiletoFS* process through the TGS secure hardware.

4.3.2.3.3.4 Physical Interface

The Network Infrastructure HWCI TGS provides physical interface between the Unclassified Data Acquisition Subsystem and the Classified Data Acquisition Subsystem interval data files transfer and interface between the Unclassified Data Acquisition HWCI and the Classified Analysis HWCI. The TGS guarantees either complete and accurate deliver or no delivery at all. Table 45 provides HWCI/CSCI allocation.

4.3.2.4 CDAS_CAS

4.3.2.4.1 Waveform Data

4.3.2.4.1.1 Data Description

The Classified Data Acquisition Subsystem transfers waveform data to the Classified Analysis Subsystem for waveform data automated processing and interactive analysis. The transferred waveform data consists of waveform data files (.w files) and data descriptive records (**wfdisc**) defined in the DBDD. The waveform data files contain the actual time-series data samples and do not contain any data description.

4.3.2.4.1.2 Data Transmission

TCP/IP network communications transfers data is transferred from the Classified Data Acquisition Subsystem to the Classified Analysis Subsystem. An NFS mount also makes data available. Oracle SQL transactions update and maintain the data.

4.3.2.4.1.3 Logical Interface

The Data-Services and Data-Management CSCIs provide the logical interface for waveform data transfer from the Classified Data Acquisition Subsystem to the Classified Analysis Subsystem. Using the Data Services CSCI, the Classified Data Acquisition Subsystem loads the Classified Database with all of the data. The Classified Analysis Subsystem implements the Data Management CSCI to extract the data to be used on the Automatic and the Interactive CSCIs.

4.3.2.4.1.4 Physical Interface

The Network Infrastructure HWCI provides physical interface between the Classified Data Acquisition Subsystem and the Classified Analysis Subsystem. The Classified Data Acquisition Subsystem and the Classified Analysis Subsystem reside in the Classified Analysis HWCI. Table 45 provides HWCI/ CSCI allocation.

4.3.2.5 CDAS_CARCS

4.3.2.5.1 Waveform Data

4.3.2.5.1.1 Data Description

The Classified Data Acquisition Subsystem transfers waveform data to the Classified Archive Subsystem for long-term and permanent storage of data. The transferred waveform data consists of waveform data files (.w files) and data descriptive records (**wfdisc**), as defined in the DBDD. The waveform data files contain the actual time-series data samples and do not contain any description of the data.

4.3.2.5.1.2 Data Transmission

TCP/IP network communications transfer data from the Classified Data Acquisition Subsystem to the Classified Archive Subsystem. A Classified Data Acquisition Subsystem File System NFS mount also makes data available.

4.3.2.5.1.3 Logical Interface

The Data-Services and Data Management CSCIs provide the logical interface for invoice data file transfers from the Classified Data Acquisition Subsystem to the Classified Archive Subsystem is implemented with the. Oracle SQL transactions update and maintain the appropriate data structures.

4.3.2.5.1.4 Physical Interface

The Network Infrastructure HWCI provides physical interface between the Classified Data Acquisition Subsystem and the Classified Archive Subsystem, which provides interface between

the Classified Data Acquisition HWCI and the Classified Archive HWCI. Table 39 provides HWCI/CSCI allocation.

4.3.2.6 CAS_CARCS

4.3.2.6.1 Derived Waveform Data

4.3.2.6.1.1 Data Description

The Classified Analysis Subsystem transfers derived waveform data to the Classified Archive Subsystem for long-term and permanent storage. The transferred waveform data consists of waveform data files (.w files) and data descriptive records (**wfdisc**), as defined in the *DBDD*. The waveform data files contain the actual time-series data samples and do not contain any description of the data.

4.3.2.6.1.2 Data Transmission

TCP/IP network communications transfers data from the Classified Analysis Subsystem to the Classified Archive Subsystem. A Classified Data Acquisition Subsystem File System NFS mount also makes data available.

4.3.2.6.1.3 Logical Interface

The Data-Services, Automated, and Data-Management CSCIs provide the logical interface for waveform data transfer from the Classified Analysis Subsystem to the Classified Archive Subsystem. The Automatic CSCI automatically performs Oracle SQL transactions by and updates the database as required.

4.3.2.6.1.4 Physical Interface

The Network Infrastructure HWCI provides physical interface between the Classified Analysis Subsystem and the Classified Archive Subsystem which provides the interface between the Classified Analysis HWCI and the Classified Archive HWCI.

4.3.2.6.2 Alphanumeric Results

4.3.2.6.2.1 Data Description

The Classified Analysis Subsystem Automated and Interactive processes produce the alphanumeric data stored on the Classified Archive Subsystem. The alphanumeric data interface consists of a header followed by multiple records.

4.3.2.6.2.2 Data Transmission

TCP/IP network communications transfer data from the Classified Analysis Subsystem to the Classified Archive Subsystem. A Classified Data Acquisition Subsystem File System NFS mount also makes data available.

4.3.2.6.2.3 Logical Interface

The Data-Services, Automatic, and Data-Management CSCIs provide the logical interface for alphanumeric data transfer from the Classified Analysis Subsystem to the Classified Archive Subsystem. The Automatic CSCI automatically performs Oracle SQL transactions and updates the database, as required.

4.3.2.6.2.4 Physical Interface

The Network Infrastructure HWCI provides physical interface between the Classified Analysis Subsystem and the Classified Archive Subsystem, which provides the interface between the Classified Analysis HWCI and the Classified Archive HWCI.

5. United States National Data Center Requirements Traceability

Table 46 provides US NDC S/SS to CSCI, computer software component (CSC) and HWCI requirements mapping.

Note: Undefined acronyms within specifications in this table which have not been used and defined previously in this SSDD will not be defined or included in Section 7.1 Acronyms and Abbreviations as the specifications are copied to this document from the US NDC S/SS (Phase 2).

Table 46. United States National Data Center Requirements Traceability Matrix

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS2: The US NDC shall provide interactive functionality to execute all automated data acquisition, data processing, and data storage functions.	Distributed	<i>Launch, WorkFlow</i>	
P2SSS3: The US NDC shall provide functionality to initiate and interrupt all automated processing tasks on the system from a controlled interface.	Distributed	<i>Launch, tuxpad, WorkFlow</i>	
P2SSS4: The US NDC shall be able to automatically initiate processing based on configurable criteria including, as a minimum, time, availability of data, and completion of prior processing steps.	Distributed	<i>tin_server, tin_server</i>	
P2SSS5: The US NDC shall control sequencing of multiple processes so dependent processes are executed in sequential or parallel paths.	Distributed	<i>tuxshell, Sequencer</i>	
P2SSS6: The US NDC shall provide configurable sequencing for processes, and shall support rule-based processing of sequential tasks such that the success or failure of one task can initiate another task.	Distributed	<i>tuxshell, Sequencer</i>	
P2SSS7: The US NDC shall provide status for all automated processes.	Distributed	<i>Launch, tuxpad, WorkFlow</i>	
P2SSS8: The US NDC shall provide logging for all automated processes.	Distributed		
P2SSS9: The US NDC shall provide a common interface for the review of all logs.	Distributed		

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS10: The US NDC shall provide functionality to automatically and immediately notify users at the System Operations Manager (SOM) and Data Acquisition Manager (DAM) consoles of the failure of any individual process.	Distributed	<i>Launch,</i> <i>tuxpad</i>	Analyst/Evaluator, Network Infrastructure
P2SSS11: The US NDC shall acquire waveform data in the format outlined in section 3.3.2 of this document.	Data-Services	<i>DLMan,</i> <i>FrameEx,</i> <i>StationToFS</i>	
P2SSS12: The US NDC shall automatically acquire unprocessed waveform data at the capacity characterized in Table 1.	Data-Services		Unclassified Data Acquisition, Unclassified Archive, Classified Analysis, Classified Archive
P2SSS13: The US NDC shall acquire and validate authenticated data using SDAS OMS software. (Deferred)			
P2SSS14: The US NDC shall monitor remote field stations. (Deferred)			
P2SSS15: The US NDC shall provide a continuous display of all seismic, hydroacoustic, and infrasonic station and sensor status. (Deferred)			
P2SSS16: The US NDC shall provide a GUI to continuously display unprocessed waveforms. (Deferred)			
P2SSS17: The US NDC shall provide a GUI to continuously monitor communications between the US NDC and external sites. (Deferred)			
P2SSS18: The US NDC shall provide a GUI to continuously monitor remote seismic, hydroacoustic and infrasonic field sensors and digitizers. (Deferred)			
P2SSS19: The US NDC shall provide a GUI to continuously monitor radionuclide stations. (Deferred)			
P2SSS20: The US NDC shall calibrate and control remote field stations. (Deferred)			
P2SSS21: The US NDC shall transmit calibration and control signals to all AFTAC-controlled sensor stations listed in the US NDC NDDOC dated April 2001. (Deferred)			

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS22: The US NDC shall provide a GUI to perform maintenance tasks associated with field site calibration, analysis, diagnostics, and communications. (Deferred)			
P2SSS23: The US NDC shall remotely command, control, configure, and reconfigure, seismic hydroacoustic, and infrasonic field equipment. (Deferred)			
P2SSS24: The US NDC shall provide a GUI that displays calibration analysis results from seismic, hydroacoustic, and infrasonic sites. (Deferred)			
P2SSS25: The US NDC shall automatically update sensor calibration results for seismic, hydroacoustic, and infrasonic sites, provided the results are available in the protocol. (Deferred)			
P2SSS26: The US NDC shall automatically update sensor calibration information for seismic, hydroacoustic, and infrasonic sites. (Deferred)			
P2SSS27: The US NDC shall provide a GUI that displays frequency, amplitude, and phase response values for each seismic, hydroacoustic, and infrasonic site. (Deferred)			
P2SSS28: The US NDC shall store frequency, amplitude, and phase response values for each seismic, hydroacoustic, and infrasonic site acquired at the US NDC. (Deferred)			
P2SSS29: The US NDC shall automatically acquire all IDC waveform availability data in alphanumeric format within one hour of the IDC making the data available to the NDC.	Data-Management		
P2SSS31: The US NDC shall automatically acquire all USGS alphanumeric bulletin products in alphanumeric format within one hour of the USGS making the data available to the NDC.	Data-Management	<i>InsertArrivals</i>	
P2SSS32: The US NDC shall acquire ancillary data available in CD 1.0 and 1.1 frames, from sensor sites.	Data-Services	<i>DLParse</i>	
P2SSS33: The US NDC shall provide a comprehensive GUI that displays ancillary data from sensor sites. The GUI will be integrated with station and sensor status displays. (Deferred)			

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS34: The US NDC shall ensure data integrity through data acquisition statistics tracked on an individual channel basis as a function of time for seismic, hydroacoustic, and infrasonic waveform data. (Deferred)			
P2SSS35: The US NDC data acquisition statistics shall track latency, gaps, and zero fills in data acquired at the US NDC unclassified and classified subsystems' front-end, and data acquired on the US NDC classified subsystem from the US NDC unclassified subsystem. (Deferred)			
P2SSS36: The US NDC shall track station connections to the US NDC unclassified and classified subsystems' front-end.	Data-Services		
P2SSS37: The US NDC shall distinguish between missing and incomplete waveform data if supported by the data transfer protocol.	Data-Services	<i>FrameEx,</i> <i>FiletoFS</i>	
P2SSS38: The US NDC shall automatically monitor the timing of acquired waveform data intervals by measuring the latency time between data recorded at the sensor and acquired at the front-end of the US NDC by using McTool, WorkFlow, and PerfMon.	Distributed, Monitoring	<i>WorkFlow,</i> <i>PerfMon</i>	
P2SSS39: The US NDC shall automatically monitor and log missing waveform data.	Data-Services		
P2SSS40: The US NDC unclassified subsystem shall automatically forward all acquired waveform data to the classified subsystem within 60 seconds of receiving the data at the unclassified US NDC front-end.	Data-Services	<i>FStoFile</i>	Network Infrastructure
P2SSS41: The US NDC shall automatically forward data, within 60 seconds of acquiring the data from US territorial stations identified in the Comprehensive Test Ban Treaty (CTBT), to the IDC.	Data-Services	<i>ExCHr,</i> <i>FrameEx,</i> <i>FStoAlpha</i>	
P2SSS42: The US NDC shall verify 100% of the available waveform data in the source buffers has transferred entirely and correctly to the destination buffers prior to any deletion command being given to the source buffers.	Data-Services, Data-Management		Unclassified Data Acquisition, Unclassified Archive, Classified Analysis, Classified Archive

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS43: The US NDC classified subsystem shall automatically generate a bulletin requesting re-transmission of corrupt and missing data from the unclassified subsystem. Missing/corrupt frames will be added to the bulleting when they are 60 seconds past due (based on time of receipt of adjacent frames). Missing/corrupt frames will be removed from the bulleting as they arrive, or when more than ten days past-due. The US NDC classified subsystem shall automatically generate a bulletin requesting re-transmission of any channel of corrupt and missing data from the unclassified subsystem within 60 seconds of the end of the frame until all corrupt and missing data is acquired.	Data-Services	<i>FiletoFS, MLView, FStoFile</i>	
P2SSS44: The US NDC classified subsystem shall continuously perform Global processing.	Automatic, Interactive, Distributed		
P2SSS45: The US NDC classified subsystem shall automatically produce a Global bulletin using seismic and hydroacoustic stations, the latter being included with the hydroacoustic associations being added and seismic events relocated through Event-Driven Processing (EDP).	Automatic	<i>DFX, StaPro, GAassoc, GAconflict, EvLoc, HAE</i>	
P2SSS46: The US NDC classified subsystem shall process and interpret teleseismic and regional seismic data during Global processing.	Automatic, Interactive		
P2SSS47: The US NDC classified subsystem shall provide the capacity to simultaneously support up to two Broad Area processing regions within the Global processing pipeline.	Automatic, Interactive		Classified Analysis
P2SSS48: The US NDC classified subsystem shall provide initial Global processing results within 60 minutes of receipt of the seismic waveform data.	Automatic, Interactive, Distributed	<i>tin_server</i>	
P2SSS49: The US NDC classified subsystem shall provide functionality to execute a Spotlight processing pipeline concentrating on specific source regions.	Automatic, Interactive, Distributed	<i>tin_server</i>	
P2SSS50: The US NDC classified subsystem shall provide the capacity to support up to eight Spotlight regions as provided by GFE.	Automatic, Interactive		Classified Analysis

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS51: The US NDC classified subsystem shall provide the capacity to perform Spotlight processing using up to eight seismic stations per Spotlight area as provided by GFE.	Automatic, Interactive		Classified Analysis
P2SSS52: The US NDC classified subsystem shall provide initial results of Spotlight processing within 30 minutes of the seismic waveform data becoming available.	Automatic, Interactive, Distributed	<i>tis_server</i>	
P2SSS53: The US NDC classified subsystem shall support Spotlight regions as large as 1,000,000 square-km as provided by GFE.	Automatic, Interactive		
P2SSS54: The US NDC classified subsystem shall provide functionality to configure Spotlight processing to suit the regions of interest.	Automatic, Interactive, Distributed		
P2SSS55: The US NDC classified subsystem shall provide functionality to execute a Forward processing pipeline concentrating on specific source regions.	Automatic, Interactive, Distributed		
P2SSS56: The US NDC classified subsystem shall provide the capacity to support up to ten Forward processing regions simultaneously.	Automatic, Interactive, Distributed		Classified Analysis
P2SSS57: The US NDC classified subsystem shall provide the capacity to perform Forward processing using up to ten seismic stations per Forward processing region.	Automatic, Interactive, Distributed		
P2SSS58: The US NDC classified subsystem shall provide initial results of Forward processing within ten minutes of the seismic waveform data becoming available.	Automatic, Interactive, Distributed	<i>tis_server, tin_server, DFX, EvWarning</i>	
P2SSS59: The US NDC classified subsystem shall notify system operators immediately upon formation of an event in the Forward processing pipeline.	Distributed	<i>WorkFlow</i>	Analyst/Evaluator
P2SSS60: The US NDC classified subsystem shall support Forward processing regions as large as 160,000 square-km.	Automatic, Interactive		
P2SSS61: The US NDC classified subsystem shall provide the functionality to configure the data processing and display parameters on a station-by-station basis to suit the regions of interest within the Forward processing pipeline.	Automatic, Interactive		
P2SSS62: The US NDC classified subsystem shall provide functionality to reprocess data in a limited time window using a Backward processing pipeline.	Automatic, Interactive, Distributed		

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS63: The US NDC classified subsystem shall provide the capacity to perform Backward processing for up to two selected regions simultaneously.	Data-Management, Distributed		
P2SSS64: The US NDC classified subsystem shall provide temporary storage for Backward processing equivalent to 12 weeks of alphanumeric results from Global processing.	Data-Management		Classified Analysis
P2SSS65: The US NDC classified subsystem shall provide the capacity to store up to 48 hours of waveform data from the Global processing network in support of Backward processing.	Data-Management		Classified Analysis
P2SSS66: The US NDC classified subsystem shall provide functionality to configure Backward processing to suit the regions of interest.	Automatic, Interactive		
P2SSS67: The US NDC classified subsystem shall provide Backward processing results within one minute of completion of processing.	Data-Management		
P2SSS68: The US NDC classified subsystem shall perform detection processing on continuous data from seismic stations.	Automatic, Distributed	<i>tis_server, DFX</i>	
P2SSS69: The US NDC classified subsystem shall perform seismic detection processing on data intervals at least two minutes in duration.	Automatic, Distributed	<i>tis_server, DFX</i>	
P2SSS70: The US NDC classified subsystem shall automatically apply detection processing to late-arriving data.	Automatic, Distributed	<i>tis_server, DFX</i>	
P2SSS71: The US NDC classified subsystem shall perform detection processing on continuous data from hydroacoustic stations.	Automatic, Distributed	<i>tis_server, DFX</i>	
P2SSS72: The US NDC classified subsystem shall perform hydroacoustic detection processing on data intervals at least ten minutes in duration.	Automatic	<i>DFX</i>	
P2SSS73: The US NDC classified subsystem shall provide the capacity to process up to 55 hydroacoustic channels at a sample rate of 250 samples per second in the Global pipeline.	Automatic, Interactive, Data-Management		Classified Analysis
P2SSS74: The US NDC classified subsystem shall provide functionality to configure detection processing parameters on a detector channel-by-detector channel basis.	Automatic	<i>DFX</i>	

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS75: The US NDC classified subsystem shall provide functionality to configure detection processing parameters to focus on a specific source region.	Automatic	<i>DFX</i>	
P2SSS76: The US NDC classified subsystem shall obtain site-specific station geometry from the database.	All		
P2SSS77: The US NDC classified subsystem shall provide functionality to identify and repair single-point spikes in waveform data.	Automatic, Interactive	<i>DFX, XfkDisplay, hydrodisplay</i>	
P2SSS78: The US NDC classified subsystem shall provide functionality to identify and mark data gaps in waveform data.	Automatic, Interactive	<i>DFX, XfkDisplay, hydrodisplay</i>	
P2SSS79: The US NDC classified subsystem shall provide functionality to identify and remove array waveform channels with anomalous amplitudes.	Automatic, Interactive,	<i>DFX, XfkDisplay, hydrodisplay</i>	
P2SSS80: The US NDC classified subsystem shall provide functionality to mask data quality control problems that cannot be repaired.	Automatic, Interactive,	<i>DFX, XfkDisplay, hydrodisplay</i>	
P2SSS81: The US NDC classified subsystem shall provide functionality to demean input waveform segments.	Automatic, Interactive	<i>DFX, XfkDisplay, hydrodisplay</i>	
P2SSS82: The US NDC classified subsystem shall provide functionality to determine data quality statistics automatically.	Automatic	<i>DFX</i>	
P2SSS83: The US NDC classified subsystem shall provide functionality to form coherent beams at array sites steered to a given azimuth and slowness prior to detection.	Automatic	<i>DFX</i>	
P2SSS84: The US NDC classified subsystem shall provide functionality to form incoherent beams at array sites steered to a given azimuth and slowness prior to detection.	Automatic	<i>DFX</i>	
P2SSS85: The US NDC classified subsystem shall provide functionality to filter raw channels or beams using Butterworth IIR filters prior to detection.	Automatic	<i>DFX</i>	
P2SSS86: The US NDC classified subsystem shall provide functionality to detect signals using the STA/LTA detector.	Automatic	<i>DFX</i>	
P2SSS87: The US NDC classified subsystem shall provide functionality to detect signals using the Z detector.	Automatic	<i>DFX</i>	

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS88: The US NDC classified subsystem shall provide functionality to detect signals using the log-Z detector.	Automatic	<i>DFX</i>	
P2SSS89: The US NDC classified subsystem shall provide functionality to detect signals using the auto-regressive detector as provided by GFE.	Automatic	<i>DFX</i>	
P2SSS90: The US NDC classified subsystem shall provide functionality to detect signals using the F-statistic detector as provided by GFE.	Automatic	<i>DFX</i>	
P2SSS91: The US NDC classified subsystem shall provide functionality to detect signals using the waveform correlation detector as provided by GFE, if this Phase 1 Upgrade capability is available prior to the Build 1 software baseline freeze.	Automatic	<i>DFX</i>	
P2SSS92: The US NDC classified subsystem shall provide functionality to allow insertion of new detector algorithms.	Automatic	<i>DFX</i>	
P2SSS93: The US NDC classified subsystem shall perform signal detection using detection thresholds approved by the Government.	Automatic	<i>DFX</i>	
P2SSS94: The US NDC classified subsystem shall provide functionality to identify and cull signal detections occurring on multiple beams.	Automatic	<i>DFX</i>	
P2SSS95: The US NDC classified subsystem shall provide the capacity to store up to 60,000 detections per day stored online for the life of the system.	Data-Management		Classified Analysis, Classified Archive
P2SSS96: The US NDC classified subsystem shall measure signal back-azimuth and slowness for detected phases at array stations using FK techniques.	Automatic	<i>DFX</i>	
P2SSS97: The US NDC classified subsystem shall determine the F-statistic and estimate uncertainties in measured azimuth and slowness obtained from FK analysis.	Automatic	<i>DFX</i>	
P2SSS98: The US NDC classified subsystem shall measure signal back-azimuth and slowness for P-type phases at three-component stations using polarization techniques.	Automatic	<i>DFX</i>	
P2SSS99: The US NDC classified subsystem shall estimate onset times of detecting short-period signals.	Automatic	<i>DFX</i>	

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS100: The US NDC classified subsystem shall estimate the ratio of signal to noise amplitude for each detected signal.	Automatic	<i>DFX</i>	
P2SSS101: The US NDC classified subsystem shall estimate the dominant period of detected signals.	Automatic	<i>DFX</i>	
P2SSS102: The US NDC classified subsystem shall provide functionality to measure peak-to-trough amplitudes in user specified time windows.	Automatic	<i>DFX</i>	
P2SSS103: The US NDC classified subsystem shall provide functionality to measure amplitude in moving STA windows.	Automatic	<i>DFX</i>	
P2SSS104: The US NDC classified subsystem shall provide functionality to correct amplitude measurements for instrument response at the observed period.	Automatic	<i>DFX</i>	
P2SSS105: The US NDC classified subsystem shall estimate features from hydroacoustic signals as provided by GFE.	Automatic	<i>DFX</i>	
P2SSS106: The US NDC classified subsystem shall provide functionality to store a representative beam for each detection.	Automatic	<i>DFX</i>	
P2SSS107: The US NDC classified subsystem shall store data quality statistics, detection information and measured features for use by later processing.	Automatic	<i>DFX</i>	
P2SSS108: The US NDC classified subsystem shall automatically perform phase identification in each processing pipeline.	Automatic	<i>StaPro, GAassoc, GAconflict</i>	
P2SSS109: The US NDC classified subsystem shall automatically group phases from common events in all processing pipelines.	Automatic	<i>StaPro, GAassoc, GAconflict</i>	
P2SSS110: The US NDC classified subsystem shall automatically provide initial phase identification for each detected signal based upon measured features of that detection.	Automatic	<i>StaPro</i>	
P2SSS111: The US NDC classified subsystem shall identify teleseismic phases.	Automatic	<i>StaPro</i>	
P2SSS112: The US NDC classified subsystem shall automatically differentiate primary and secondary teleseismic phases.	Automatic	<i>StaPro</i>	

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS113: The US NDC classified subsystem shall provide functionality to automatically identify local and regional seismic P and S phases in selected regions.	Automatic	<i>StaPro</i>	
P2SSS114: The US NDC classified subsystem shall automatically identify hydroacoustic H and T phases.	Automatic	<i>StaPro</i>	
P2SSS115: The US NDC classified subsystem shall provide functionality to configure initial phase identification to use station-dependent methods.	Automatic	<i>StaPro</i>	
P2SSS116: The US NDC classified subsystem shall automatically group teleseismic signals from a single station that emanates from the same event.	Automatic	<i>StaPro</i>	
P2SSS117: The US NDC classified subsystem shall automatically group hydroacoustic signals from a single station that emanates from the same event.	Automatic	<i>StaPro</i>	
P2SSS118: The US NDC classified subsystem shall automatically associate all signals from a network of seismic stations that emanate from the same event using travel-time prediction and signal features.	Automatic	<i>GAassoc, GAconflict</i>	
P2SSS119: The US NDC classified subsystem shall provide functionality to automatically refine phase identification after association to an event.	Automatic	<i>GAassoc, GAconflict</i>	
P2SSS120: The US NDC classified subsystem shall associate a given detection to no more than one event in a given pipeline.	Automatic	<i>GAconflict</i>	
P2SSS121: The US NDC classified subsystem shall provide functionality to automatically associate hydroacoustic phases to events formed using the seismic technique.	Automatic	<i>DFX</i>	
P2SSS122: The US NDC classified subsystem shall provide functionality to utilize the best path-dependent information available on the system during automatic association.	Automatic	<i>StaPro, GAassoc, GAconflict</i>	
P2SSS123: The US NDC classified subsystem shall provide functionality to automatically associate detected signals with existing event hypotheses as those detections become available.	Automatic	<i>GAassoc, GAconflict</i>	

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS124: The US NDC classified subsystem shall retain event hypotheses meeting configurable acceptance criteria.	Automatic	<i>GAassoc, GAconflict</i>	
P2SSS125: The US NDC classified subsystem shall provide functionality to automatically locate events using signal arrival time, back azimuth and slowness.	Automatic	<i>StaPro, GAassoc, GAconflict</i>	
P2SSS126: The US NDC classified subsystem shall automatically locate all events satisfying configurable minimum-data criteria.	Automatic	<i>StaPro, GAassoc, GAconflict</i>	
P2SSS127: The US NDC classified subsystem shall provide functionality to automatically locate events using seismic signals, hydroacoustic signals or combinations thereof.	Automatic	<i>StaPro, GAassoc, GAconflict</i>	
P2SSS128: The US NDC classified subsystem shall automatically locate events at depth for events satisfying configurable criteria.	Automatic	<i>GAassoc, GAconflict</i>	
P2SSS129: The US NDC classified subsystem shall estimate uncertainties in all computed locations, including predicted data residuals.	Automatic	<i>StaPro, GAassoc, GAconflict</i>	
P2SSS130: The US NDC classified subsystem shall provide functionality to use the best available information in the US NDC system for automatic location.	Automatic	<i>StaPro, GAassoc, GAconflict</i>	
P2SSS131: The US NDC classified subsystem shall provide functionality to use travel-time correction surfaces and regional travel-time tables provided by GFE for automatic location.	Automatic	<i>StaPro, GAassoc, GAconflict</i>	
P2SSS132: The US NDC classified subsystem shall automatically determine event magnitudes for all located events with sufficient amplitude measurements for the purpose of characterizing the event source.	Automatic,	<i>StaPro, GAassoc, GAconflict, EvLoc</i>	
P2SSS133: The US NDC classified subsystem shall automatically determine mb.	Automatic	<i>GAassoc, GAconflict, EvLoc</i>	
P2SSS134: The US NDC classified subsystem shall provide functionality to determine maximum-likelihood estimates of mb and Ms.	Automatic	<i>EvLoc</i>	
P2SSS135: The US NDC classified subsystem shall provide functionality to automatically determine regional magnitude in selected regions, as provided by GFE.	Automatic	<i>StaPro</i>	

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS136: The US NDC classified subsystem shall provide functionality to configure regional magnitude processing to selected regions of interest.	Automatic,	<i>StaPro</i>	
P2SSS137: The US NDC classified subsystem shall estimate the uncertainties of all computed magnitudes.	Automatic	<i>StaPro,</i> <i>GAassoc,</i> <i>GAconflict,</i> <i>EvLoc</i>	
P2SSS138: The US NDC classified subsystem shall provide functionality to use the best available attenuation information in the US NDC system for automatic magnitude determination.	Automatic, Interactive	<i>StaPro,</i> <i>GAassoc,</i> <i>GAconflict,</i> <i>EvLoc</i>	
P2SSS139: The US NDC classified subsystem shall store the results of phase identification, association, location and magnitude estimation to be accessible by subsequent processes.	Data-Management		
P2SSS140: The US NDC classified subsystem shall store origin beams and detection beams for associated detections for each event.	Data-Management		
P2SSS141: The US NDC classified subsystem shall perform post-analysis event identification.	Interactive	<i>Discrim,</i> <i>hydrodisplay</i>	
P2SSS142: The US NDC classified subsystem shall provide functionality to perform event identification in the Global processing pipeline.	Interactive	<i>Discrim,</i> <i>hydrodisplay</i>	
P2SSS143: The US NDC classified subsystem shall classify events using teleseismic <i>Discriminants</i> consistent with the rules given in “Event Classification Procedures for the Seismic Technique (REF 11),” dated 5 April 1982.	Interactive,	<i>Discrim</i>	
P2SSS144: The US NDC classified subsystem shall determine if an event is located within the Area-Of-Interest (AOI) and store that designation with other event information.	Interactive, Data-Management	<i>ARS</i>	
P2SSS145: The US NDC classified subsystem shall provide functionality to modify the AOI to meet changing mission objectives.	Data-Management		
P2SSS146: The US NDC classified subsystem shall store the results of event identification with other event information for use by subsequent processing and analysis.	Data-Management, Interactive		
P2SSS147: The US NDC classified subsystem shall provide functionality to train neural networks for initial wave-type identification.	Tuning	<i>NNET</i>	

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS148: The US NDC classified subsystem shall provide functionality to compute new Bayesian inference tables for regional phase identification from historical data.	Tuning	<i>Bayes_convert</i>	
P2SSS149: The US NDC classified subsystem shall provide functionality to create and view grid files used in automated network association.	Tuning	<i>GAcons, GAgid</i>	
P2SSS150: The US NDC classified subsystem shall provide documentation to assist in testing and understanding the functions and primary configuration parameters of the system used for automated network association.	Tuning	<i>GA_tutorial</i>	
P2SSS151: The US NDC classified subsystem shall provide functionality to review the results of all automatic processing.	Interactive	<i>all</i>	
P2SSS152: The US NDC classified subsystem shall provide interactive functionality to edit the results of all automatic processing.	Interactive	<i>ARS</i>	
P2SSS153: The US NDC classified subsystem shall provide interactive functionality to edit stored analysis results.	Interactive	<i>ARS</i>	
P2SSS154: The US NDC classified subsystem shall provide functionality to compare results of automatic processing to all analyzed results.	Interactive, Data-Management	<i>ARS, EventList, Bulletin</i>	
P2SSS155: The US NDC classified subsystem shall retain all original processing results when edited.	Data-Management		
P2SSS156: The US NDC classified subsystem shall permit analysis of results without impact to automatic processing.	Distributed, Interactive		
P2SSS157: The US NDC classified subsystem shall provide access to and the functionality to include all available data during analysis, including data not available at the time of previous processing.	Data-Management		
P2SSS158: The US NDC classified subsystem shall store the results of each analysis stage.	Data-Management		
P2SSS159: The US NDC classified subsystem shall provide functionality to automatically prepare origin beams for array sensor stations, in the predicted arrival time window and steered to an event, for display during analysis.	Automatic	<i>DFX</i>	

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS160: The US NDC classified subsystem shall provide functionality to automatically determine hydroacoustic azimuths in preparation for analysis.	Automatic	<i>HAE</i>	
P2SSS161: The US NDC classified subsystem shall provide functionality to perform automatic processing between each stage of analysis.	Automatic, Distributed	<i>sequencer, DFX, EvLoc</i>	
P2SSS162: The US NDC classified subsystem shall provide functionality to display data for each waveform type individually by technique.	Interactive	<i>ARS</i>	
P2SSS163: The US NDC classified subsystem shall provide functionality to manipulate waveform data, including scrolling, zooming and filtering of the data.	Interactive	<i>ARS</i>	
P2SSS164: The US NDC classified subsystem shall provide functionality to edit any measurement used for location, magnitude or <i>Discriminant</i> analysis.	Interactive	<i>ARS, Discrim, hydrodisplay</i>	
P2SSS165: The US NDC classified subsystem shall provide functionality to modify phase identification of data used for event location.	Interactive	<i>ARS</i>	
P2SSS166: The US NDC classified subsystem shall provide interactive functionality to compute event location.	Interactive	<i>ARS, GAim</i>	
P2SSS167: The US NDC classified subsystem shall automatically compute, display, and save event location results for depth constrained to the surface of the earth, depth unconstrained, and a user-selected depth, and use the results in subsequent processing.	Interactive	<i>ARS</i>	
P2SSS168: The US NDC classified subsystem shall provide interactive functionality to select those data that are defining for event location.	Interactive	<i>ARS</i>	
P2SSS169: The US NDC classified subsystem shall provide functionality for specifying user-selected location parameters.	Interactive	<i>ARS</i>	
P2SSS170: The US NDC classified subsystem shall provide functionality to specify travel-time tables used for location.	Interactive	<i>ARS</i>	
P2SSS171: The US NDC classified subsystem shall provide functionality to select any available regionalized corrections to travel-times tables.	Interactive	<i>ARS</i>	

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS172: The US NDC classified subsystem shall provide functionality to perform event location using test-site travel-time corrections.	Interactive	<i>ARS</i>	
P2SSS173: The US NDC classified subsystem shall provide interactive functionality to compute all event magnitudes used in the system.	Interactive	<i>ARS</i>	
P2SSS174: The US NDC classified subsystem shall provide interactive functionality to select those data that are defining for event magnitude, while preserving all individual station magnitudes.	Interactive	<i>ARS</i>	
P2SSS175: The US NDC classified subsystem shall provide interactive functionality to allow user selection of magnitude parameters.	Interactive	<i>ARS</i>	
P2SSS176: The US NDC classified subsystem shall provide functionality to specify attenuation tables used for magnitude.	Automatic, Interactive	<i>StaPro, GAassoc, GAconflict, EvLoc, ARS</i>	Classified Analysis
P2SSS177: The US NDC classified subsystem shall provide functionality to compute magnitude using test-site magnitude corrections.	Automatic	<i>ARS, EvLoc</i>	Classified Analysis
P2SSS178: The US NDC classified subsystem shall provide functionality to use all automatic processing algorithms during interactive analysis.	Automatic, Interactive	all	Classified Analysis
P2SSS179: The US NDC classified subsystem shall provide functionality to interactively generate origin and detection beams.	Interactive, Automatic	<i>DFX, XfkDisplay</i>	Classified Analysis
P2SSS180: The US NDC classified subsystem shall provide functionality to form beams for three-component data using polarization techniques.	Interactive	<i>XfkDisplay</i>	
P2SSS181: The US NDC classified subsystem shall provide functionality to modify detection beam parameters.	Interactive	<i>XfkDisplay</i>	
P2SSS182: The US NDC classified subsystem shall by default generate beams with parameters identical to those used in automatic processing.	Automatic, Interactive	<i>DFX, XfkDisplay</i>	
P2SSS183: The US NDC classified subsystem shall provide interactive functionality to determine back azimuth and apparent velocity from array data using FK analysis.	Interactive	<i>XfkDisplay</i>	

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS184: The US NDC classified subsystem shall provide functionality to modify parameters controlling FK analysis.	Interactive	<i>XfkDisplay</i>	
P2SSS185: The US NDC classified subsystem shall provide functionality to determine back azimuth and apparent velocity for P- and LR-type waves from three-component seismic stations using polarization analysis.	Interactive	<i>XfkDisplay</i>	
P2SSS186: The US NDC classified subsystem shall provide functionality to interactively review hydroacoustic azimuths determined in pre-analysis processing.	Interactive	<i>HART</i>	
P2SSS187: The US NDC classified subsystem shall provide functionality to automatically perform event formation using user-selected detections.	Interactive	<i>ARS, GAim</i>	
P2SSS188: The US NDC classified subsystem shall provide functionality to automatically determine signal-to-noise ratios for analyst-added detections.	Automatic	<i>DFX</i>	
P2SSS189: The US NDC classified subsystem shall provide functionality for reviewing selected seismic <i>Discrimination</i> results.	Interactive	<i>Discrim</i>	
P2SSS190: The US NDC classified subsystem shall provide interactive functionality for selection of those data used in seismic <i>Discriminant</i> analysis.	Interactive	<i>Discrim</i>	
P2SSS191: The US NDC classified subsystem shall provide interactive functionality to modify <i>Discrimination</i> results.	Interactive	<i>Discrim</i>	
P2SSS192: The US NDC classified subsystem shall provide functionality for reviewing hydroacoustic <i>Discrimination</i> results, as provided by GFE.	Interactive	<i>hydrodisplay</i>	
P2SSS193: The US NDC classified subsystem shall provide interactive functionality for selection of those data used in hydroacoustic <i>Discriminant</i> analysis, as provided by GFE.	Interactive	<i>hydrodisplay</i>	
P2SSS194: The US NDC classified subsystem shall provide functionality to review the results of event identification.	Interactive	<i>Discrim, hydrodisplay</i>	
P2SSS195: The US NDC classified subsystem shall provide functionality for user-selection of <i>Discriminants</i> to be used in event identification.	Interactive	<i>Discrim, hydrodisplay</i>	

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS196: The US NDC classified subsystem shall provide functionality to automatically access, spatially manipulate, and spatially process geographically referenced information required for data processing provided by GFE.	Interactive	<i>ArcShell</i>	
P2SSS197: The US NDC classified subsystem shall provide functionality to store, manage, maintain, analyze, and manipulate spatial data as provided by GFE.	Interactive, Data-Management	<i>ArcShell</i>	
P2SSS198: The US NDC classified subsystem shall provide the functionality to maintain change control of geographical information in the system, including the history of data updates and modifications, as provided by GFE.	Data-Management		
P2SSS199: The US NDC classified subsystem shall provide functionality to display and process geographical information as provided by GFE.	Interactive	<i>ArcShell</i>	
P2SSS200: The US NDC classified subsystem shall provide functionality to display event, detection and station information in conjunction with spatial data.	Interactive	<i>MAP, ArcShell</i>	
P2SSS201: The US NDC classified subsystem shall provide interactive functionality to manipulate and process spatial data as provided by GFE.	Interactive	<i>ArcShell</i>	
P2SSS202: The US NDC classified subsystem shall provide functionality to generate high quality graphical and tabular presentations of the results of spatial processing of geographical data as provided by GFE.	Interactive	<i>ArcShell</i>	
P2SSS203: The US NDC classified subsystem shall provide functionality to generate bulletins for all processing modes.	Automatic, Interactive	<i>StaPro, GAconflict, Bulletin, EventList</i>	
P2SSS204: The US NDC classified subsystem shall provide functionality to generate bulletins after all processing stages, in automated processing and in interactive analysis, that result in event forming.	Automatic, Interactive	<i>StaPro, GAconflict, Bulletin, EventList</i>	
P2SSS205: The US NDC classified subsystem shall provide functionality to generate event bulletins containing information about the network solution (latitude, longitude, time, depth, magnitude) and information about station associations.	Automatic, Interactive	<i>StaPro, GAconflict, Bulletin, EventList</i>	

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS206: The US NDC classified subsystem shall perform comparisons between two bulletins that will identify common events and characterize the differences in their solutions.	Monitoring	<i>BullComp</i>	
P2SSS207: The US NDC classified subsystem shall provide functionality to perform bulletin comparisons using event information.	Monitoring	<i>BullComp</i>	
P2SSS208: The US NDC classified subsystem shall provide functionality to perform bulletin comparisons using both event and arrival information.	Monitoring	<i>BullComp</i>	
P2SSS209: The US NDC classified subsystem shall provide functionality to automatically monitor data processing functions.	Monitoring	<i>PerfMon</i>	
P2SSS210: The US NDC classified subsystem shall provide functionality to interactively monitor data processing functions through a GUI.	Monitoring	<i>PerfMon</i>	
P2SSS211: The US NDC classified subsystem shall provide functionality to evaluate the performance of data processing functions using specified metrics.	Monitoring	<i>PerfMon</i>	
P2SSS212: The US NDC classified subsystem shall provide functionality to automatically generate performance monitoring reports as regularly scheduled products.	Monitoring	<i>PerfMon</i>	
P2SSS213: The US NDC classified subsystem shall provide interactive functionality to generate performance monitoring reports.	Monitoring	<i>PerfMon</i>	
P2SSS214: The US NDC classified subsystem shall provide functionality to automatically collect historical averages of station detection rates.	Monitoring	<i>PerfMon</i>	
P2SSS215: The US NDC classified subsystem shall provide functionality to configure parameters so as to perform statistical comparisons between stored results from any processing stage in any pipeline mode of the US NDC.	Monitoring	<i>BullComp</i>	
P2SSS216: The US NDC classified subsystem shall provide functionality to configure parameters so as to perform statistical bulletin comparisons between stored results of the US NDC and other operational systems whose results are stored using the applicable version of the US NDC Database Schema.	Monitoring	<i>PerfMon</i>	

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS217: The US NDC classified subsystem shall provide functionality to generate graphical displays of bulletin comparisons, including event maps and graphs of location differences.	Monitoring	<i>PerfMon</i>	
P2SSS218: The US NDC classified subsystem shall provide functionality to interactively customize performance monitoring reports, including selection of time windows and comparisons to include.	Monitoring	<i>PerfMon</i>	
P2SSS219: The US NDC classified subsystem shall provide functionality to display in color a generated performance report.	Monitoring	<i>PerfMon</i>	
P2SSS220: The US NDC classified subsystem shall provide functionality to generate color copies on paper and transparencies of a generated performance report.	Monitoring	<i>PerfMon</i>	
P2SSS221: The US NDC classified subsystem shall provide functionality to monitor the timeliness of data acquisition and processing milestones on the classified subsystem.	Monitoring	<i>PerfMon</i>	
P2SSS222: The US NDC classified subsystem shall provide functionality to monitor the availability of expected data on the classified subsystem, for stations that are processed.	Monitoring	<i>PerfMon</i>	
P2SSS223: The US NDC classified subsystem shall provide functionality to monitor the quality of acquired data, including percentage of data masked due to spikes or drop-outs, and the number of masked segments, for stations that are processed.	Monitoring	<i>PerfMon</i>	
P2SSS224: The US NDC classified subsystem shall provide functionality to monitor station noise levels for acquired data, for stations that are processed.	Monitoring	<i>PerfMon</i>	
P2SSS225: The US NDC classified subsystem shall provide functionality to monitor station detection thresholds using Chi-square analysis.	Monitoring	<i>PerfMon</i>	
P2SSS226: The US NDC classified subsystem shall provide functionality to monitor station detection rates.	Monitoring	<i>PerfMon</i>	
P2SSS227: The US NDC classified subsystem shall provide functionality to monitor the rates of associated automated detections and of analyst-added phases.	Monitoring	<i>PerfMon</i>	

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS228: The US NDC classified subsystem shall provide functionality to monitor the accuracy of amplitude and period measurements.	Monitoring	<i>PerfMon</i>	
P2SSS229: The US NDC classified subsystem shall provide functionality to monitor the accuracy of slowness estimation through statistical analysis of slowness residuals.	Monitoring	<i>PerfMon</i>	
P2SSS230: The US NDC classified subsystem shall provide functionality to monitor the accuracy of azimuth estimation through statistical analysis of azimuth residuals.	Monitoring	<i>PerfMon</i>	
P2SSS231: The US NDC classified subsystem shall provide functionality to monitor the accuracy of arrival time estimation through statistical analysis of time residuals.	Monitoring	<i>PerfMon</i>	
P2SSS232: The US NDC classified subsystem shall provide functionality to graphically display the geographic, depth and magnitude distributions of events formed by the automated processing or after analyst review.	Monitoring	<i>PerfMon</i>	
P2SSS233: The US NDC classified subsystem shall provide functionality to monitor the accuracy of initial phase identification.	Monitoring	<i>PerfMon</i>	
P2SSS234: The US NDC classified subsystem shall provide functionality to monitor the accuracy of final phase identification after event location.	Monitoring	<i>PerfMon</i>	
P2SSS235: The US NDC classified subsystem shall provide functionality to monitor the performance of hydroacoustic event-driven processing.	Monitoring	<i>PerfMon</i>	
P2SSS236: The US NDC classified subsystem shall provide functionality to perform statistical evaluations of automated events that are not validated (false alarms).	Monitoring	<i>PerfMon</i>	
P2SSS237: The US NDC classified subsystem shall provide functionality to perform statistical evaluations of missed events and missed associations.	Monitoring	<i>PerfMon</i>	
P2SSS238: The US NDC classified subsystem shall provide functionality to perform statistical evaluations of events common to the automated bulletin and an analyst-reviewed bulletin.	Monitoring	<i>PerfMon</i>	

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS239: The US NDC classified subsystem shall provide functionality to monitor the use of locating phases in interactive analysis, including teleseismic branches, regional phases and depth phases.	Monitoring	<i>PerfMon</i>	
P2SSS240: The US NDC classified subsystem shall provide interactive functionality to monitor the retiming of arrivals in interactive analysis.	Monitoring	<i>PerfMon</i>	
P2SSS241: The US NDC classified subsystem shall provide interactive functionality to monitor the association and disassociation of automated detections in interactive analysis.	Monitoring	<i>PerfMon</i>	
P2SSS242: The US NDC Training System shall provide all analysis tools available in the US NDC classified subsystem.	Interactive		
P2SSS243: The US NDC Training System shall provide the instructor with access to all analysis and maintenance functions.			Training System
P2SSS244: The US NDC Training System shall provide compatible software to allow interaction between student and instructor workstations for both analysis and computer-assisted instruction.			Training System
P2SSS245: The US NDC Training System shall project instructor workstation activities to student workstation displays.			Training System
P2SSS246: The US NDC Training System shall project student activities to the instructor workstation display.			Training System
P2SSS247: The US NDC Training System shall provide functionality to execute processes for analysis data preparation and student account management from the instructor workstation.	Distributed	<i>Launch, WorkFlow</i>	
P2SSS248: The US NDC Training system shall provide functions necessary to interrupt processes for analysis data preparation and student account management from the instructor workstation.	Distributed	<i>Launch, WorkFlow</i>	
P2SSS249: The US NDC Training System shall notify the instructor of the failure of processes for analysis data preparation and student account management.	Distributed	<i>WorkFlow</i>	
P2SSS250: The US NDC Training System shall log all processes for analysis data preparation and student account management.	Automatic, Data-Management		

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS251: The US NDC Training System shall automatically store all classified data processing results.	Automatic, Interactive		
P2SSS252: The US NDC Training System shall provide the functions necessary to automatically generate detection beams using parameters derived from frequency-wave number analysis.	Automatic	<i>DFX</i>	
P2SSS253: The US NDC Training System shall provide the functions necessary to automatically generate origin beams for the primary P wave steered to origins in the database.	Automatic	<i>DFX</i>	
P2SSS254: The US NDC Training System shall provide the functions necessary to automatically generate origin beams for long-period phases for origins in the database.	Automatic	<i>DFX</i>	
P2SSS255: The US NDC Training System shall provide functionality to configure all beam parameters.	Automatic		
P2SSS256: The US NDC classified subsystem shall meet or exceed the capabilities of the Phase 1 system for the rate of analyst-verified detections.	Automatic, Monitoring	<i>DFX, PerfMon</i>	
P2SSS257: The US NDC classified subsystem shall meet or exceed the capabilities of the Phase 1 system for automated measurement of onset time.	Automatic, Monitoring	<i>DFX, PerfMon</i>	
P2SSS258: The US NDC classified subsystem shall meet or exceed the capabilities of the Phase 1 system for automated measurement of amplitude and period.	Automatic, Monitoring	<i>DFX, PerfMon</i>	
P2SSS259: The US NDC classified subsystem shall meet or exceed the capabilities of the Phase 1 system for automated measurement of array vector slowness.	Automatic, Monitoring	<i>DFX, PerfMon</i>	
P2SSS260: The US NDC classified subsystem shall meet or exceed the capabilities of the Phase 1 system for the rate of analyst-verified automated events.	Automatic, Monitoring	<i>GAassoc, GAconflict, PerfMon</i>	
P2SSS261: The US NDC classified subsystem shall meet or exceed the capabilities of the Phase 1 system for the amount of time it takes to read intervals of both seismic and hydroacoustic data in interactive analysis.	Interactive,	<i>ARS</i>	Classified Analysis, Analyst/Evaluator

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS262: The US NDC classified subsystem shall meet or exceed the capabilities of the Phase 1 system for the amount of time it takes to scroll displayed channels of both seismic and hydroacoustic data in interactive analysis.	Interactive	<i>ARS</i>	Classified Analysis, Analyst/Evaluator
P2SSS263: The US NDC classified subsystem shall meet or exceed the capabilities of the Phase 1 system for the amount of time it takes to perform beamforming of seismic data in interactive analysis.	Automatic, Interactive	<i>DFX, XfkDisplay</i>	Classified Analysis, Analyst/Evaluator
P2SSS264: The US NDC classified Phase 2 subsystem shall meet or exceed the capabilities of the Phase 1 system for the amount of time it takes to perform frequency-wave number FK analysis of seismic data in interactive analysis.	Interactive	<i>XfkDisplay</i>	Classified Analysis, Analyst/Evaluator
P2SSS265: The US NDC classified subsystem shall meet or exceed the capabilities of the Phase 1 system for the amount of time it takes to run automated pipeline processes (e.g., HydroEDP) between analysis stages in interactive analysis.	Distributed, Automatic	<i>DFX, EvLoc</i>	Classified Analysis
P2SSS266: The US NDC unclassified subsystem shall support a physical interface to the existing AFTAC Headquarters unclassified network.			Unclassified Data Acquisition
P2SSS267: The US NDC unclassified subsystem shall receive all data from unclassified external sources via its connection to the existing AFTAC Headquarters unclassified network.			Unclassified Data Acquisition
P2SSS268: The US NDC unclassified subsystem shall forward all data to unclassified external clients via its connection to the existing AFTAC Headquarters unclassified network.			Unclassified Data Acquisition
P2SSS269: The US NDC unclassified subsystem shall be capable of exchanging electronic mail with other AFTAC unclassified Local Area Networks (LAN), other external sources and clients, and the Internet via the AFTAC Headquarters unclassified network.			Unclassified Data Acquisition
P2SSS270: The US NDC unclassified subsystem shall provide read-only access to selected files and database tables to other AFTAC unclassified LANs via the AFTAC Headquarters unclassified network.	Data-Management		Unclassified Data Acquisition, Unclassified Archive

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS271: The US NDC unclassified subsystem shall obtain Network Time Protocol (NTP)-based time information via a time source on the AFTAC Headquarters unclassified network.			Unclassified Data Acquisition
P2SSS273: The US NDC classified subsystem shall support a physical connection to the existing AFTAC Headquarters classified network.			Classified Analysis
P2SSS274: The US NDC classified subsystem shall be capable of exchanging electronic mail with other AFTAC classified LANs via the AFTAC Headquarters classified network.			Classified Analysis
P2SSS275: The US NDC classified subsystem shall provide read-only access to selected files and database tables. This access will be granted to other AFTAC classified LANs via the AFTAC Headquarters classified network.	Data-Management		Classified Analysis, Classified Archive
P2SSS276: The US NDC classified subsystem shall obtain NTP-based time information via a time source on the AFTAC Headquarters classified network.			Classified Analysis
P2SSS277: The US NDC shall support a physical interface to the ADSN archive system. The US NDC shall support a physical interface to the ADSN archive system.			Unclassified Data Acquisition
P2SSS278: The US NDC shall have read-only access to the waveform files and database of the ADSN archive system.	Data-Management		Unclassified Data Acquisition, Unclassified Archive
P2SSS279: The US NDC shall support a physical interface to the AFTAC Hydro system.			Unclassified Data Acquisition
P2SSS280: The US NDC shall receive hydroacoustic waveform data via its physical interface to the AFTAC Hydro system.	Data-Services		Classified Analysis
P2SSS283: The US NDC shall support Simple Mail Transfer Protocol (SMTP) for all electronic mail communications via its external interfaces.			Unclassified Data Acquisition, Classified Analysis
P2SSS284: The US NDC shall support NTP for synchronization of all processors to a common time standard.			All
P2SSS285: The US NDC shall forward waveform data to clients using the CD 1.0 and CD 1.1 protocols.	Data-Services	<i>FrameEx, ExCtrl, ConnOrig, FStoAlpha</i>	Unclassified Data Acquisition

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS286: The US NDC shall receive waveform data using the CD 1.0 and CD 1.1 protocols from all stations, which support these protocols.	Data-Services	<i>ConnMgr, ExCtrl, FrameEx, ConnMan</i>	Unclassified Data Acquisition, Classified Analysis
P2SSS287: The US NDC shall receive waveform data from USAEDS stations using the Data Transaction Center (DTC) protocol.	Data-Services	<i>StationToFS</i>	Unclassified Data Acquisition
P2SSS288: The US NDC shall receive waveform data from ASN stations in the form of CSS 3.0 datafiles.	Data-Services	<i>StationToFS</i>	Unclassified Data Acquisition
P2SSS289: The US NDC shall receive waveform data from LANL in the form of SUDS datafiles.	Data-Services	<i>GFE: Artm</i>	
P2SSS290: The US NDC classified subsystem shall provide functions to write data to portable media readable by the US NDC Training System.	Data-Management	<i>TrainingExport</i>	
P2SSS291: The US NDC Training System shall provide a GUI to monitor the status of processes for analysis data preparation.	Distributed	<i>WorkFlow</i>	
P2SSS292: The US NDC Training System shall provide a GUI to monitor the status of processes for student account management.	Data-Management, Distributed	<i>Launch</i>	
P2SSS293: The US NDC Training System shall be designed to allow loading of alphanumeric data obtained from the US NDC in Oracle export format.	Data-Management	<i>TrainingInsert</i>	
P2SSS294: The US NDC Training System shall provide functionality to load waveform data from the US NDC available in UNIX tar format.	Data-Management	<i>TrainingImport</i>	
P2SSS295: The US NDC Training System shall provide functionality to read data from portable media prepared on the US NDC.	Data-Management	<i>TrainingImport</i>	Training System
P2SSS296: The US NDC Training System shall provide a GUI to form detection beams on array detections in a user-selected time interval.	Distributed	<i>WorkFlow</i>	
P2SSS297: The US NDC Training System shall provide a GUI to form origin beams on origins in a user-selected time interval.	Distributed	<i>WorkFlow</i>	
P2SSS298: The US NDC Training System shall provide a GUI to load waveform and alphanumeric data over a user-selected time interval.	Data-Management, Distributed	<i>TrainingInsert, WorkFlow</i>	

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS299: The US NDC Training System shall provide a GUI to delete waveform and alphanumeric data over a user-selected time interval.	Data-Management, Distributed	<i>TrainingDelete, WorkFlow</i>	
P2SSS300: The US NDC Training System shall support sets of individual database accounts for twelve (12) students to allow each student to perform individual analysis for each of the following processing modes: global, hydro, spotlight and forward.	Data-Management, Distributed	<i>Launch</i>	
P2SSS301: The US NDC Training System shall provide a GUI to create student database accounts.	Data-Management, Distributed	<i>Launch</i>	
P2SSS302: The US NDC Training System shall provide a GUI to remove student database accounts.	Data-Management, Distributed	<i>Launch</i>	
P2SSS303: The US NDC Training System student accounts shall have access to all data prepared by the instructor.			Training System
P2SSS304: The US NDC shall automatically backup all on-line waveform data.	Data-Management		
P2SSS305: The US NDC shall automatically backup all off-line waveform data.	Data-Management		
P2SSS306: The US NDC shall automatically backup all alphanumeric data.	Data-Management		
P2SSS307: The US NDC automated backup functionality shall be capable of running concurrently with automated data acquisition, data processing, and data storage functions.	Data-Management		
P2SSS308: The US NDC shall incorporate functionality to restore all backup waveform data.	Data-Management		Classified Analysis, Classified Archive
P2SSS309: The US NDC classified subsystem shall restore all backup alphanumeric data.	Data-Management		Classified Analysis, Classified Archive
P2SSS310: The US NDC shall store waveform data in CSS 3.0 wfdisc format.	Data-Services	<i>DLParse, ArchiveLongTerm</i>	
P2SSS311: The US NDC shall be composed of COTS hardware that does not require the use of toxic products or hazardous materials during normal operation or preventive maintenance tasks.			All

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS312: The US NDC shall be composed of COTS hardware that does not contain volatile organic compounds (VOCs), or require the use of VOCs for normal operation or to perform preventive maintenance procedures.			All
P2SSS313: The US NDC shall acquire, process and store data up to the Department of Defense (DoD) Secret level in accordance with (IAW) DAA approved Air Force Manual 33-229, 1 November 1997, Controlled Access Protection (CAP) for Information Security Systems (IS).	All		All
P2SSS314: The US NDC shall be connected to external interfaces by way of an AFTAC provided firewall to protect it from external access by unauthorized personnel.			Unclassified Data Acquisition
P2SSS315: The US NDC shall verify user identity prior to gaining access to the US NDC.			All
P2SSS316: The US NDC shall prevent the inadvertent disclosure of information to unauthorized users by protecting primary storage, fixed media, removable media, etc. IAW the object reuse requirements of the CAP for IS systems.			All
P2SSS317: The US NDC shall segregate configuration files containing classified or sensitive information into clearly marked directories.	All		
P2SSS318: The US NDC shall comply with security standards IAW the CAP for legacy systems.	All		All
P2SSS319: The US NDC shall employ security measures to prevent files containing classified information from being transmitted to the unclassified subsystem.	Data-Services		Classified Analysis, Analyst/Evaluator, Classified Archive, Network Infrastructure
P2SSS320: The US NDC shall limit remote system access to specific authorized lists of users on specific authorized machines IAW the discretionary access procedures established in the CAP.			All
P2SSS321: The US NDC shall protect the integrity of data from unauthorized modification.	Data-Management		All

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS322: The US NDC shall provide dependable audit capabilities that have the ability to selectively acquire and support tracing events to specific users.			All
P2SSS323: The US NDC shall require identification and authentication of all users attempting to log on to the system IAW the CAP for legacy systems.			All
P2SSS324: The US NDC shall provide warning banners advising users of system monitoring activities prior to completion of user login as part of the CAP auditing functionality.			All
P2SSS325: The US NDC shall provide one-way data flow from the unclassified to the classified subsystem.			Network Infrastructure
P2SSS326: The US NDC shall provide system security protection for all message transfers from the classified to the unclassified subsystem.			Network Infrastructure
P2SSS327: The hardware components of the US NDC shall provide hardware capable of operating with 110-120/220-240 volts AC, 60 Hz, single/three phase power.			All
P2SSS328: The US NDC shall operate from the facility □ninterruptible power supply (UPS) system to protect the COTS hardware from damaging voltage irregularities and power loss.			All
P2SSS329: The US NDC shall provide hardware components specified to operate within the temperature range of 60 to 90 degrees Fahrenheit.			All
P2SSS330: The US NDC hardware components shall be specified to operate within the relative humidity range of 20% to 80%, non-condensing.			All
P2SSS332: The US NDC shall provide hardware components specified to produce no more than 85db acoustic noise while operating.			All
P2SSS333: The US NDC shall provide the functions to perform orderly shutdown and startup.			All
P2SSS334: The US NDC shall provide functionality to restart each workstation individually without affecting the operation of other workstations in the system.			Analyst/Evaluator

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS335: The US NDC hardware elements shall meet commercial standards for electrostatic discharge.			All
P2SSS336: The US NDC computer hardware shall comply with Part 15 of the Federal Communications Commission (FCC) rules for Class A or Class B digital devices.			All
P2SSS337: The US NDC shall be constructed using COTS hardware.			All
P2SSS338: The US NDC Training System shall utilize hardware functionally compatible with the US NDC system.			Training System
P2SSS340: The US NDC Training System shall provide a workstation for the instructor.			Training System
P2SSS341: The US NDC Training System shall provide workstations to accommodate six (6) students.			Training System
P2SSS342: The US NDC Training System shall provide functionality to produce high quality, black-and-white and color, hard copy reports and graphical output.			Training System
P2SSS343: The US NDC Training System shall use interchangeable workstations and LRUs for items replicated in the training system.			Training System
P2SSS344: The US NDC Training System shall provide functionality to perform an orderly startup and shutdown.			Training System
P2SSS345: The US NDC Training System shall provide functionality to automatically shutdown prior to losing backup power from a UPS.			Training System
P2SSS346: The US NDC unclassified subsystem shall have the capacity to store waveform data as characterized in Table 1 for up to 13 days in on-line short-term storage.			Unclassified Data Acquisition
P2SSS347: The US NDC shall provide system-level access to all waveform data in on-line short-term storage with latency to first data accessed, of less than five seconds.			Unclassified Data Acquisition, Classified Analysis
P2SSS348: The US NDC shall transfer waveform data from on-line short-term storage at a rate of at least 500 kilobytes per second.			Unclassified Data Acquisition, Classified Analysis

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS349: The US NDC classified subsystem shall have the capacity to store waveform data characterized in Table 1 for at least 45 days in on-line short-term storage.			Classified Analysis
P2SSS350: The US NDC unclassified subsystem shall have the capacity to store waveform data as characterized in Table 1 for at least 180 days in on-line long-term storage.			Unclassified Archive
P2SSS351: The US NDC classified subsystem shall have the capacity to store waveform data as characterized in Table 1 for at least 60 days in on-line long-term storage.			Classified Analysis
P2SSS352: The US NDC shall provide access to waveform data in on-line long-term storage with a latency, to first data accessed, of less than one hour.			Unclassified Archive, Classified Archive
P2SSS353: The US NDC shall transfer waveform data from long-term storage at a rate of at least 500 kilobytes per second.			Unclassified Archive, Classified Archive
P2SSS354: The US NDC shall provide access to waveform data in off-line permanent storage with a latency, to first data accessed, of less than one hour from the time the tape is loaded onto the system.			Classified Archive
P2SSS355: The US NDC shall transfer waveform data from off-line permanent storage at a rate of at least 500 kilobytes per second.			Classified Archive
P2SSS356: The US NDC classified subsystem shall have the capacity to store waveform data characterized in Table 1 and associated waveform descriptor records over 180 days old for the life of the system in off-line permanent storage.	Data-Management	ArchivePermanent	Classified Archive
P2SSS357: The US NDC shall store all waveform and alphanumeric data on portable permanent storage media.	Data-Management	<i>ArchivePermanent, ArchiveData</i>	Classified Archive
P2SSS358: The US NDC unclassified subsystem shall have the capacity to buffer at least 8 hours of all incoming waveform data, as characterized in Table 1.	Data-Services	<i>libfs</i>	
P2SSS359: The US NDC classified subsystem shall have the capacity to buffer at least 8 hours of all incoming waveform data, as characterized in Table 1.	Data-Services	<i>libfs</i>	

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS360: The US NDC shall use storage media that has a minimum 10-year shelf life.			Media
P2SSS361: The US NDC unclassified subsystem shall have a database with the table space capacity to store 180 days of alphanumeric wfdisc records on-line.	Data-Management		Unclassified Archive
P2SSS362: The US NDC unclassified subsystem database shall have the table space capacity to store 180 days of alphanumeric IDC bulletin data on-line.	Data-Management		Unclassified Data Acquisition
P2SSS363: The US NDC classified subsystem shall have a database with the table space capacity to store all alphanumeric data processing and analysis records on-line for the life of the system.	Data-Management		Classified Archive
P2SSS364: The US NDC shall provide functionality to store all data processing results off-line.	Data-Management		Classified Archive
P2SSS366: The US NDC Training System shall make waveform data on-line and accessible to other processes with a latency (to first data accessed) of less than five seconds and with a sustainable transfer rate of greater than 500 kilobytes per second.			Training System
P2SSS368: The US NDC Training System shall make alphanumeric data available to other processes with a latency (to first data accessed) of less than five seconds and with a sustainable transfer rate of greater than 500 kilobytes per second.	Data-Management		Training System
P2SSS369: The US NDC Training System shall automatically backup all derived waveform and alphanumeric data once daily to offline storage.	Data-Management		Training System
P2SSS370: The US NDC Training System shall restore data from an offline backup.	Data-Management		Training System
P2SSS371: The US NDC Training System shall provide functionality to ensure data storage integrity of all data.	Data-Management		Training System
P2SSS372: The US NDC software shall be written in high order programming languages, minimizing the number of languages.	All		
P2SSS373: The US NDC shall make maximum use of COTS and Government off the Shelf (GOTS) software.	All		

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS374: The US NDC shall have software with a uniform and consistent user interface for access to all the interactive processing functionality within the US NDC.	Interactive		
P2SSS375: The US NDC shall provide a COTS DBMS and a system infrastructure to manage databases such that data is continuously processed within the US NDC without interruptions.	Data-Management		
P2SSS376: The US NDC shall incorporate the Oracle Server Enterprise Edition product, version 8.1.7.	Data-Management		
P2SSS377: The US NDC shall provide a COTS distributed processing system to manage distributed processes.	Distributed		
P2SSS378: The US NDC Training System shall provide software required for database management of student accounts.	Data-Management		
P2SSS379: The US NDC Training System shall utilize software compatible with the US NDC.	All		Training System
P2SSS380: The US NDC shall be partitioned into discrete subsystems that are connected through a local area network (LAN).			All
P2SSS381: The US NDC shall have a hardware mission MTBCF of no less than 2160 hours when operating in an environment specified in Section 3.9 of this document. The MTBCF parameter is based on MCH.			All
P2SSS382: The US NDC shall have a mission profile of operating 52 weeks per year, 7 days per week and 24 hours per day.	All		All
P2SSS383: The US NDC hardware MRT shall be 21.8 hours. The MRT parameter is based on MCH.			All
P2SSS384: The US NDC shall have a hardware MTTR of less than two hours at the 95 th percentile.			All
P2SSS385: The US NDC shall be designed for organizational and depot levels of maintenance.			All
P2SSS386: The US NDC shall provide functionality to automatically monitor, collect, and report fault information.			Solaris

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS387: The US NDC shall achieve a minimum time between preventive maintenance routines (PMRs) of 720 hours.			All
P2SSS388: The US NDC shall not have system outages due to PMRs.			All
P2SSS389: The US NDC COTS hardware selection shall consider fault detection and isolation capabilities to maximize MCH failure detection and reporting.			All
P2SSS390: The US NDC shall detect and report the loss of a storage device.			All
P2SSS391: The US NDC shall maximize the use of storage devices (controller modules, disk trays, drives, etc.) that have the capabilities of automatic failover and hot spare.			All
P2SSS392: The US NDC shall allow for data recovery in the event of storage device failure.			All
P2SSS393: All US NDC detected hardware faults shall be isolated to one LRU as directed by the COTS Field Engineering Handbook for the given hardware system using a combination of automatic fault isolation and interactive troubleshooting.			All
P2SSS394: The US NDC shall be designed to enable LRU removal, replacement, and reinstallation within one hour.			All
P2SSS395: A sparing analysis shall be conducted after CDR by a joint Government and Contractor team. MCH will be evaluated for suitable sparing levels to support mission availability requirements.			
P2SSS396: The US NDC data storage function shall be designed so that individual storage devices may be removed and replaced without loss of data or system integrity.			All
P2SSS397: The US NDC repair time for MCH failures shall not exceed 4 hours.			All
P2SSS398: The US NDC shall maximize the use of interchangeable workstations, LRUs and other interchangeable hardware.			All
P2SSS399: The US NDC shall provide a minimum operational availability of 99%.			All

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS400: The US NDC Training System shall support mission duration of 8 hours per day, 5 days per week, 250 days per year.			Training System
P2SSS401: The US NDC Training System shall provide a minimum MTBCF of 1500 hours. A critical failure is defined as a failure that requires longer than 2 hours to repair.			Training System
P2SSS402: The US NDC Training System shall provide an MTTR of less than 2 hours for 95% of repairs.			Training System
P2SSS403: The US NDC Training System shall include the functionality to isolate all faults to one LRU using a combination of fault isolation and interactive troubleshooting procedures contained in system documentation.			Training System
P2SSS404: The US NDC Training System shall support the use of an alternate storage device to allow for continued system operations in the event of a storage device failure.			Training System
P2SSS405: The US NDC Training System shall be designed to enable LRU removal, replacement, and reinstallation within one hour.			Training System
P2SSS406: The US NDC Training System data storage function shall be designed so that individual storage devices may be removed and replaced without loss of data or system integrity.			Training System
P2SSS407: The US NDC Training System shall be designed for a two-level (organizational and depot) maintenance concept.			Training System
P2SSS408: The US NDC Training System shall provide a minimum time between PMRs of 720 hours.			Training System
P2SSS409: The US NDC Training System shall provide system documentation appropriate for the organizational and depot maintenance levels.			Training System
P2SSS410: The US NDC shall be designed to have its hardware and software incrementally upgraded over its operational lifetime, including the ability to add functionality, increase processing capacity, and increase memory storage capacity without unplanned loss of previous capabilities.	All		All

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS411: The US NDC classified subsystem shall provide the functionality to interactively process acquired waveform data from auxiliary seismic stations, if this Phase 1 Upgrade functionality is available prior to the Build 1 software baseline freeze.	Interactive	<i>ARS</i>	
P2SSS413: The US NDC Training System shall be equipped with an in-line uninterruptible power supply function that provided a minimum of 30 minutes of backup power.			Training System
P2SSS436: The US NDC Training System shall operate at an acoustic noise level of less than 85 decibels.			Training System
P2SSS437: The US NDC Training System shall acquire, process, and store data up to the DoD Secret level in accordance with CAP procedure established by the US Air Force for legacy based IS.			Training System
P2SSS442: The US NDC Training System shall be composed of COTS hardware that does not require the use of toxic products or hazardous materials during normal operation or preventive maintenance tasks.			Training System
P2SSS443: The US NDC Training System shall be composed of COTS hardware that does not contain volatile organic compounds (VOCs), or require the use of VOCs for normal operation or to perform preventive maintenance procedures.			Training System
P2SSS451: The US NDC Training System shall have hardware capable of operating with 110-120/220-240 volts AC, 60 Hz, single/three phase power.			Training System
P2SSS452: The US NDC Training System shall provide hardware components specified to operate within the temperature range of 60 to 90 degrees Fahrenheit.			Training System
P2SSS453: The US NDC Training System components shall be specified to operate within the relative humidity range of 20% to 80%, non-condensing.			Training System
P2SSS454: The US NDC Training System hardware elements shall meet commercial standards for electrostatic discharge.			Training System

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS455: The US NDC Training System computer hardware shall comply with Part 15 of the Federal Communications Commission (FCC) rules for Class A or Class B digital devices.			Training System
P2SSS456: The US NDC Training System shall be written in high order programming languages, minimizing the number of languages.	All		
P2SSS457: The US NDC Training System shall have software with a uniform and consistent user interface for access to all the interactive processing functionality within the Training System.	Interactive		
P2SSS458: The US NDC Training System shall provide a COTS DBMS and a system infrastructure to manage databases such that data is continuously processed within the Training System without interruptions.			Training System
P2SSS459: The US NDC Training System shall be designed to have its hardware and software incrementally upgraded over its operational lifetime, including the ability to add functionality, increase processing capacity, and increase memory storage capacity without unplanned loss of previous capabilities			Training System
P2SSS460: The US NDC Training System shall provide on-line storage capacity for at least fifteen (15) 24 hour days of waveform data for all stations characterized in Table 1. Use of existing storage hardware and its capacity of 18GB per day is acceptable.			Training System
P2SSS461: The US NDC Training System shall provide functionality to edit any measurement used for location, magnitude or <i>Discriminant</i> analysis.	Automatic		
P2SSS462: The US NDC Training System shall retain all original processing results when edited.	Interactive		
P2SSS463: The US NDC Training System shall store the results of each analysis stage.	Interactive		
P2SSS464: The US NDC Training System shall provide functionality to automatically perform event formation using user-selected detections.	Automatic		

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS465: The US NDC Training System shall provide interactive functionality to select those data that are defining for event magnitude.	Interactive		
P2SSS467: The US NDC classified subsystem shall automatically perform long-period signal detection and processing through Event-Driven Processing (EDP), to associate long-period phases to events formed using short-period seismic signals, if this Phase 1 Upgrade capability is available prior to the Build 1 software baseline freeze.	Automatic	<i>DFX</i>	
P2SSS468: The US NDC shall provide functionality to produce high quality, black-and-white and color, hard copy reports and graphical output.	Monitoring	<i>PerfMon</i>	
P2SSS470: The US NDC Training System shall provide the functionality to automatically generate event reports.	Interactive		
P2SSS471: The US NDC Training System shall provide the functionality to include in event reports the following event attributes: latitude, longitude, depth/elevation, time, magnitude, priority, <i>Discrimination</i> data, waveform graphics, event summary text.	Interactive		
P2SSS472: The US NDC Training System shall limit system access to specific authorized lists of users on specific authorized machines IAW the discretionary access procedures established in the CAP.			Training System
P2SSS473: The US NDC Training System shall verify user identity prior to gaining access to the Training System.			Training System
P2SSS474: The US NDC Training System shall prevent the inadvertent disclosure of information to unauthorized users by protecting primary storage, fixed media, removable media, etc. IAW the object reuse requirements of the DAA-approved Air Force Manual 33-229, 1 November 1997, CAP for IS systems.			Training System
P2SSS475: The US NDC Training System shall comply with security standards IAW the CAP.			Training System
P2SSS476: The US NDC Training System shall protect the integrity of data from unauthorized modification.			Training System

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS477: The US NDC Training System shall provide dependable audit capabilities that have the ability to selectively acquire and support tracing events to specific users.			Training System
P2SSS479: The US NDC Training System shall require identification and authentication of all users attempting to log on to the system IAW the CAP for legacy systems.			Training System
P2SSS480: The US NDC Training System shall provide warning banners advising users of system monitoring activities prior to completion of user login as part of the CAP auditing functionality.			Training System
P2SSS482: The US NDC Training System shall make maximum use of COTS and Government off the Shelf (GOTS) software.			Training System
P2SSS483: The US NDC classified subsystem shall provide the functionality to prepare teleseismic and regional beams for short-period, broadband and long-period seismic signals, for display during analysis.	Automatic	<i>DFX</i>	
P2SSS484: The US NDC classified subsystem shall provide the functionality to make measurements on processed and unprocessed data.	Automatic	<i>DFX</i>	
P2SSS485: The US NDC classified subsystem shall provide the functionality to interactively initiate all Event-Driven Processing (EDP) functions.	Automatic, Interactive	<i>DFX, ARS</i>	
P2SSS486: The US NDC Training System shall provide on-line storage capacity for at least 15 days of seismic and hydroacoustic alphanumeric data from the US NDC under nominal loading. Use of existing storage hardware and its capacity of 18 GB per day is acceptable.			Training System
P2SSS487: The US NDC unclassified subsystem shall automatically request, when protocol allows, retransmission of corrupt and missing waveform data from any acquisition site within one hour of initial data transfer until all corrupt and missing data is acquired.	Data-Services	<i>FrameEx</i>	
P2SSS488: The US NDC classified subsystem shall provide functionality to allow the insertion of new types of filters.	Automatic	<i>DFX</i>	

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS489: The US NDC classified subsystem shall provide functionality to allow insertion of new algorithms for data quality control.	Automatic, Interactive	<i>DFX, XfkDisplay, Hydrodisplay</i>	
P2SSS490: The US NDC classified subsystem shall automatically group regional seismic signals from a single station that emanates from the same event.	Automatic	<i>Stapro</i>	
P2SSS492: The US NDC classified subsystem shall provide the functionality to automatically prepare detection beams for array sensor stations, from frequency-wave number (FK) processing, for display during analysis.	Automatic	<i>DFX</i>	
P2SSS493: The US NDC databases shall employ appropriate techniques (for example, check constraints or triggers) to prevent the entry of out-of-range data.	Data-Management		
P2SSS495: The US NDC databases shall prevent the entry of duplicate data records.	Data-Management		
P2SSS496: The US NDC databases shall enforce parent-child relationships between tables where appropriate.	Data-Management		
P2SSS497: Users of US NDC databases shall be granted privileges appropriate to their level of access by means of pre-defined roles.	Data-Management		
P2SSS498: The US NDC Oracle databases shall implement session-level temporary tables where appropriate.	Data-Management		
P2SSS499: The US NDC classified subsystem shall provide read and execution access to system applications, parameter and recipe files, and documentation from the AFTAC Headquarters classified network.			Classified Analysis
P2SSS500: The US NDC shall have the capability to automatically acquire up to 200 Mbytes of radionuclide sensor data in a 24-hour period. (Deferred)			
P2SSS502: The US NDC hardware purchased after Phase 2 Build 1 CDR shall have a 5-year service life from the conclusion of Phase 2 Build 1 SAT.			All
P2SSS503: The US NDC shall include an Operational subsystem LAN.			All

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS504: The US NDC shall include a Developmental subsystem LAN.			Server
P2SSS505: The US NDC shall include a Sustainment subsystem LAN.			All
P2SSS506: The US NDC Sustainment LAN shall be configured to allow development and testing of sustainment activities associated with the Operational subsystem.			All
P2SSS507: The US NDC shall provide a separate and distinct Training subsystem LAN.			Training System
P2SSS508: The US NDC Sustainment subsystem shall be fully functionally redundant to the Operational subsystem with the exception of shared archive components and data feeds.	All		Unclassified Data Acquisition, Unclassified Archive, Classified Analysis, Classified Archive
P2SSS509: The US NDC shall have its low-to-high data transfer mechanism enhanced to include new data application protocols and it shall meet the security requirements of the Defense Information Systems Agency Multi-level Security Office (DISA/MLS).	Data-Services	<i>FStoFile, FiletoFS</i>	
P2SSS510: The US NDC permanent storage system shall not rely on a proprietary database management system for access.	Data-Management	<i>ArchivePermanent</i>	
P2SSS511: The US NDC shall support the Transport Control Protocol/Internet Protocol (TCP/IP) suite for communications over the physical interfaces it supports.			All
P2SSS513: In the event of an outage (communications, Data Acquisition Subsystem, TGS, or Classified Analysis Subsystem), the US NDC shall acquire waveform data at no less than a 2:1 (data duration/elapsed time) ratio rate. (Depending on its capacity, a station might send 12 hours of near-realtime data while simultaneously sending 12 hours of older data).	Data-Services	<i>FrameEx, DLMan, StationToFS</i>	
P2SSS514: In the event of an outage, the US NDC Global station processing intervals shall successfully complete at no less than a 2:1 (data duration/processing duration) ratio, under non-swarm conditions.	Distributed		Classified Analysis

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS515: In the event of an outage, the US NDC Global network processing intervals shall successfully complete at no less than a 2:1 (data duration/processing duration) ratio, under non-swarm conditions.	Distributed		Classified Analysis
P2SSS516: In the event of an outage, the US NDC Spotlight station processing intervals shall successfully complete at no less than a 2:1 (data duration/processing duration ratio), under non-swarm conditions.	Distributed		Classified Analysis
P2SSS517: The US NDC Backward processing intervals shall successfully complete at no less than a 1:1 (data duration/processing duration) ratio, under non-swarm conditions.	Distributed		Classified Analysis
P2SSS518: The US NDC shall automatically acquire all IDC bulletin data in alphanumeric format within one hour of the IDC making the data available to the NDC.	Data-Management		
P2SSS519: The US NDC Training System shall operate from an uninterruptible power supply (UPS) system to protect the COTS hardware from damaging voltage irregularities and power loss.			Training System
P2SSS520: The US NDC Training System shall provide functionality to restart each workstation individually without affecting the operation of other workstations in the system.			Training System
P2SSS521: The US NDC shall support the use of an alternate storage device to allow for continued system operations in the event of a storage device failure.			All
P2SSS522: The US NDC shall provide interactive functionality to automatically execute data acquisition, data processing and data storage functions.	Distributed	<i>Launch, tuxpad</i>	
P2SSS526: The US NDC databases shall prevent entry of data records into child tables unless the appropriate matching records exist in the parent tables.	Data-Management,		
P2SSS527: The US NDC databases shall ensure that related records in child tables are deleted whenever records in parent tables are deleted.	Data-Management		

**Table 46. United States National Data Center
Requirements Traceability Matrix (Continued)**

S/SS SPECIFICATION	CSCI	CSC	HWCI
P2SSS528: Attempts by US NDC applications software to enter duplicate data records, invalid child records or out-of-range data into the US NDC databases shall be logged to application level log files.	All		
P2SSS529: The US NDC databases shall prevent entry of data records into child tables unless the appropriate matching records exist in the parent tables.	Data-Management		
P2SSS530: The US NDC shall ensure that related records in child tables are deleted whenever records in parent tables are deleted.	All		
P2SSS531: Attempts by US NDC applications software to enter duplicate data records, invalid child records or out-of-range data into the US NDC databases shall be logged to application level log files.	All		
P2SSS532: The US NDC classified subsystem shall acquire uncorrupted 99.999% of the waveform data frames forwarded from the unclassified subsystem. (This is a failure rate of approximately 1 frame per station every 12 days).	Data-Services	<i>FStoFile, FiletoFS</i>	
P2SSS533: The US NDC shall use Tuxedo Distributed Application Control Software (DACS) for distributed processing.	Distributed		Classified Analysis
P2SSS534: The US NDC classified subsystem shall provide the functionality to configure the data processing and display parameters on a station-by-station basis to suit the Broad-Area processing regions of interest within the Global processing pipeline.	Interactive, Automatic		Classified Analysis, Analyst/Evaluator
P2SSS535: The US NDC shall use a flat-file format for permanent storage.	Data-Management	<i>ArchiveLongTerm, ArchivePermanent</i>	
P2SSS536: The US NDC data transfer mechanism shall meet the security requirements of the Defense Information Systems Agency Multi-level Security Office (DISA/MLS).			Network Infrastructure
P2SSS537: The US NDC shall incorporate web-based event bulletin software. (Deferred)			

6. Alternate United States National Data Center Requirements Traceability

Table 47 provides the Alt US NDC requirements traceability matrix.

Note: Undefined acronyms within specifications in this table which have not been used and defined previously in this SSDD will not be defined or included in Section 7.1 Acronyms and Abbreviations as the specifications are copied to this document from the US NDC S/SS (Phase 2).

Table 47. Alternate United States National Data Center Requirements Traceability Matrix

SPECIFICATION	CSCI	CSC	HWCI
ALTSSS1 The Alt US NDC shall have the same data acquisition capability as the US NDC (reference US NDC SSS, section 3.2.2).	Data-Services		Unclassified Data Acquisition, Classified Analysis
ALTSSS2 During mission performance at the Alt US NDC, the Alt US NDC shall acquire data through the local AFTAC-administered network at Goodfellow rather than through the virtual private network connection with the US NDC.	Data-Services	<i>ConnMgr, FrameEx, StationToFS, DLMan</i>	Network Infrastructure, Unclassified Data Acquisition, Classified Analysis
ALTSSS3 During standby operation at the Alt US NDC, the Alt US NDC shall acquire unprocessed waveform data within 10 minutes of its availability at the US NDC.	Data-Services		Network Infrastructure, Unclassified Data Acquisition, Classified Analysis
ALTSSS4 The Alt US NDC shall provide an automated check of the completeness of the unprocessed waveform data received from the US NDC during standby to ensure that the Alt US NDC acquires 99.999% of the data forwarded from the primary US NDC. (Data forwarding to the Alt US NDC from the US NDC will be accomplished via a CR to the P2 US NDC.)	Data-Services	To be determined	Unclassified Data Acquisition, Classified Analysis
ALTSSS5 At the time of unplanned mission transfer to the Alt US NDC, the Alt US NDC shall continuously acquire unprocessed waveform data from the primary data source as the data becomes available.	Data-Services	<i>ConnMgr, FrameEx, StationToFS, DLMan</i>	Network Infrastructure, Unclassified Data Acquisition, Classified Analysis
ALTSSS6 At the time of mission return to US NDC, the Alt US NDC shall transfer any unprocessed waveform data unique to the Alt US NDC to the US NDC.	Data-Services		Unclassified Data Acquisition, Classified Analysis

Table 47. Alternate United States National Data Center Requirements Traceability Matrix (Continued)

SPECIFICATION	CSCI	CSC	HWCI
ALTSSS7 During mission performance at the Alt US NDC, e-mail sent to US NDC e-mail addresses shall be delivered to users at the Alt US NDC.			Network Infrastructure, Unclassified Data Acquisition, Classified Analysis
ALTSSS8 The unclassified subsystem shall automatically forward all waveform data to the classified subsystem within 60 seconds of receiving the data at the unclassified Alt US NDC.	Data-Services		Network Infrastructure, Unclassified Data Acquisition, Classified Analysis
ALTSSS9 The Alt US NDC shall have the same data transfer integrity capability as the US NDC (reference US NDC SSS, section 3.2.3).	Data-Services	<i>FrameEx</i> <i>StationToFS</i> <i>FStoFile</i> <i>FiletoFS</i> <i>MLView</i>	
ALTSSS10 The Alt US NDC shall have the same data processing functionality as the US NDC (reference US NDC SSS, section 3.2.4).	Automatic, Interactive	All	Classified Analysis, Analyst/Evaluator
ALTSSS11 During standby operation, the Alt US NDC shall store data processing results within 10 minutes after they are available at US NDC.	Data-Management		
ALTSSS12 The Alt US NDC shall provide an automated check of the completeness of the data processing results received from the US NDC to ensure that data is completely duplicated on the standby (receiving) system.	Data-Management		
ALTSSS13 At the time of mission return to US NDC, the Alt US NDC shall send all unique data processing results to the US NDC within 100 hours.	Data-Management		
ALTSSS14 Manually-initiated pipeline processing shall occur at Alt US NDC during mission performance.	Distributed, Automatic	<i>Launch,</i> <i>tuxpad</i>	
ALTSSS15 The Alt US NDC shall have the same process monitoring and control capability as the US NDC (reference US NDC SSS, section 3.2.1).	Distributed	<i>Launch,</i> <i>Workflow,</i> <i>tuxpad</i>	
ALTSSS16 During standby operations, the Alt US NDC shall be monitored and controlled from the US NDC.	Distributed	<i>Launch,</i> <i>Workflow,</i> <i>tuxpad</i>	
ALTSSS17 The Alt US NDC shall have the same event reporting capabilities as the US NDC (reference US NDC SSS, section 3.2.10).	Automatic, Interactive		

Table 47. Alternate United States National Data Center Requirements Traceability Matrix (Continued)

SPECIFICATION	CSCI	CSC	HWCI
ALTSSS18 The TT LAN shall have read access to the US NDC wide area network (WAN) including the US NDC and Alt US NDC LANs.			All
ALTSSS19 The Alt US NDC shall implement a DISA-approved secure gateway between its classified and unclassified elements.			Network Infrastructure
ALTSSS20 The Alt US NDC shall have the same system internal data capabilities as the US NDC (reference US NDC SSS, section 3.5).			Unclassified Data Acquisition, Classified Analysis
ALTSSS21 The safety requirements for the Alt US NDC shall be the same as for US NDC (reference US NDC SSS, Section 3.7).			All
ALTSSS22 The security and privacy requirements for the Alt US NDC shall be the same as for US NDC (reference US NDC SSS, Section 3.8).			All
ALTSSS23 The system environment requirements for the Alt US NDC shall be the same as for US NDC (reference US NDC SSS, Section 3.9).			All
ALTSSS24 The Alt US NDC shall have the same data storage functionality as US NDC (reference US NDC SSS, Section 3.10.2.1 and Section 3.10.2.2).	Data-Services Data-Management		Unclassified Data Acquisition, Unclassified Archive, Classified Analysis, Classified Archive
ALTSSS25 The Alt US NDC shall be connected to the US NDC via classified and unclassified TCP/IP networks.			Network Infrastructure
ALTSSS26 At the time of mission return to the US NDC, the Alt US NDC shall send all unique processed and unprocessed waveform data to the US NDC, at no less than a 1:1 (data duration/elapsed time) ratio rate, concurrent with new processed and unprocessed waveform data.	Data-Services		Network Infrastructure
ALTSSS27 The Alt US NDC shall be capable of supporting a mission duration of 24 hours per day, 7 days per week, 365 days per year. During standby operations, data acquisition and archiving shall be accomplished 24 hours a day, 7 days per week, for data sent from the US NDC.			All

**Table 47. Alternate United States National Data Center
Requirements Traceability Matrix (Continued)**

SPECIFICATION	CSCI	CSC	HWCI
ALTSSS28 The maintainability of the Alt US NDC shall be the same as the US NDC (reference US NDC SSS, Section 3.11.2).			All
ALTSSS29 The availability of the Alt US NDC shall be the same as the US NDC (reference US NDC SSS, Section 3.11.3).			All
ALTSSS30 The Alt US NDC shall be designed to acquire USAEDS and ASN data via the Alt ADSN Data Acquisition Subsystem.	Data-Services	<i>FrameEx StationToFS</i>	Unclassified Data Acquisition
ALTSSS31 The Alt US NDC shall provide functionality to incorporate unique processed and unprocessed waveform data and associated descriptive records from US NDC archive tapes, as an alternative to receiving the data across the network. (The same functionality will work in the other direction at the US NDC during mission return to incorporate data from the Alt US NDC archive tapes.)	Data Management		Classified Analysis, Classified Archive

7. Notes

7.1 Acronyms and Abbreviations

A list of the acronyms or abbreviations used in this document follows:

ADSN	AFTAC Distributed Subsurface Network
AFM	Air Force Manual
AFTAC	Air Force Technical Applications Center
AOI	Area of Interest
Alt	Alternate
API	Application Program Interface
ASCII	American Standard Code for Information Interchange
ASN	AFTAC Southern Network
BB	Broadband
CDRL	Contract Data Requirements List
CM	Configuration Management
CMR	Center for Monitoring Research
COTS	Commercial Off-the-Shelf
CPU	Central processing unit
CSCI	Computer Software Configuration Item
CSS	Center for Seismic Studies
DACS	Distributed Application Control System
DAM	Data Acquisition Manager
DBDD	Database Design Description
DDS	Digital data storage
DID	Data Item Description
DLP	Data link processor
DLT	Digital linear tape
DMZ	Demilitarized zone
DoE	Department of Energy
DTC	Data Transaction Center

EDP	Event Driven Processing
EEA	Event Evaluation Analyst
fft	Fast Fourier Transform
FTP	File Transfer Protocol
GA	Global Association
GAFB	Goodfellow Air Force Base
GDI	Generic database interface
GFE	Government furnished equipment
GIS	Geographical Information System
GUI	Graphical user interface
HDC	Headquarters Data Center
HWC	Hardware Component
HWCI	Hardware Configuration Item
HYDR	Hydroacoustic Station
IAW	In accordance with
ICD	Interface Control Document
IDC	International Data Centre
IMS	International Monitoring Stations
I/O	Input/output
IPC	Inter-process Communications
KB	Knowledge Base
kVA	Kilovoltampere(s)
LAN	Local Area Network
LANL	Los Alamos National Laboratories
LFNET	Look-forward Network
LFSEIS	Look-forward Seismic Station
LLNL	Lawrence Livermore National Laboratory
LP	Long Period
LS	Directorate of Logistics and Systems
Msn	Maximum-likelihood Surface-wave Noise Magnitude
MRT	Mean Restoration Time
MTBCF	Mean Time Between Critical Failures

NDI	Non-developmental Item
NFS	Network File System
NIS	Network Information Service
OAI	Outside Areas of Interest
OS	Operating System
PAFB	Patrick Air Force Base
QA	Quality Assurance
RAID	Redundant Array of Independent Disks
RDBMS	Relational Database Management System
RPC	Remote Procedure Call
SAIC	Science Applications International Corporation
SATN	Subsurface Analyst Training Network
SCSI	Small Computer System Interface
SEA	Seismic Event Analyst
SEIS	Seismic station
SNR	Signal-to-Noise Ratio
SOH	State of Health
SOM	System Operations Manager
SP	Short Period
SPOT	Spotlight seismic station
SSDD	System/Subsystem Design Description
S/SS	System/Subsystem Specification
tar	Tape archive
TCP/IP	Transmission Control Protocol/Internet Protocol
TGS	Trusted Gateway System
TI	Technical Instruction
tm	Transaction management
TT	Directorate of Nuclear Treaty Monitoring
UPS	Uninterruptible Power Supply
US NDC	United States National Data Center
USAEDS	United States Atomic Energy Detection System
VLAN	Virtual Local Area Network

WAN	Wide Area Network
WCL	Widget Creation Library